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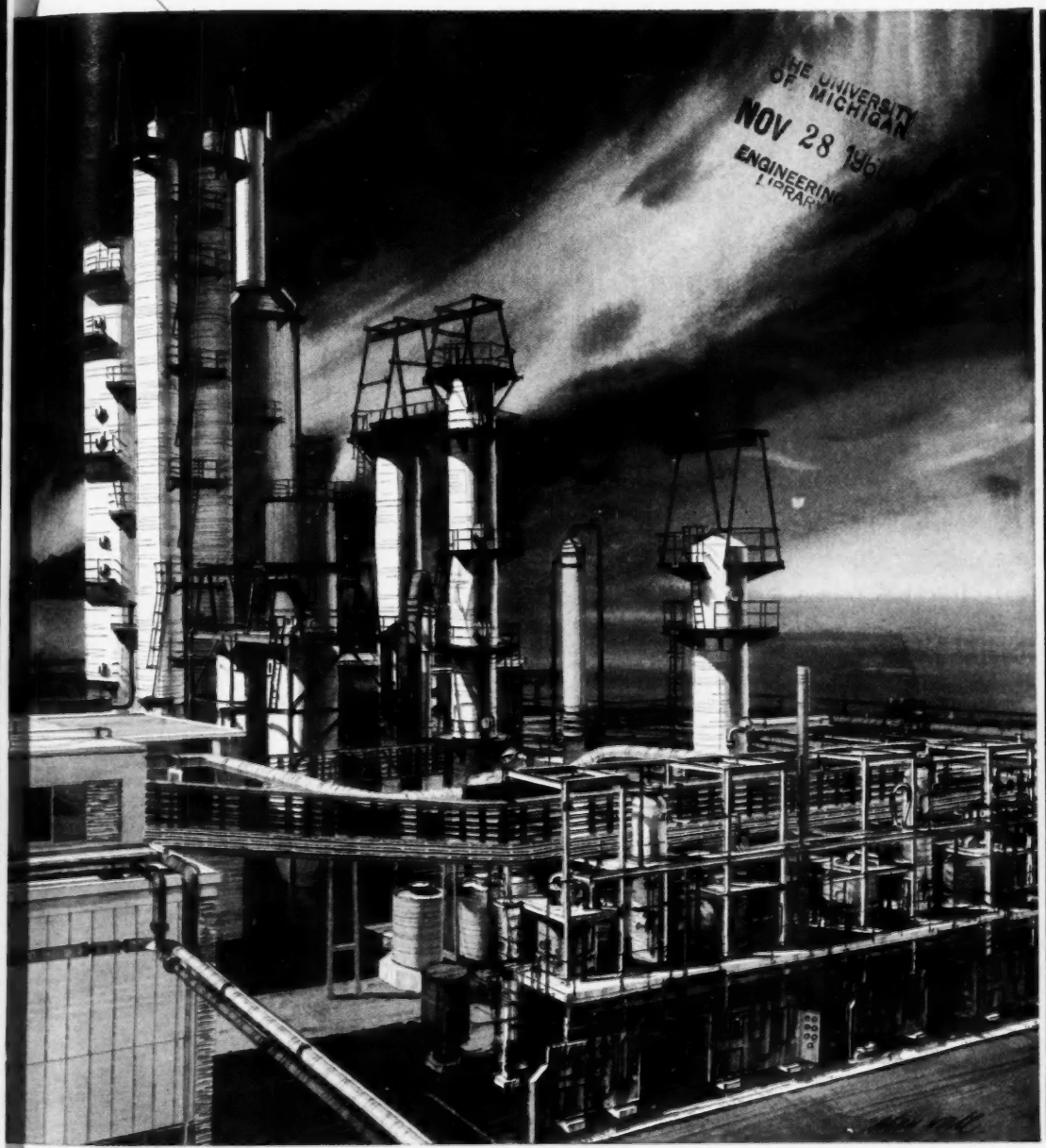

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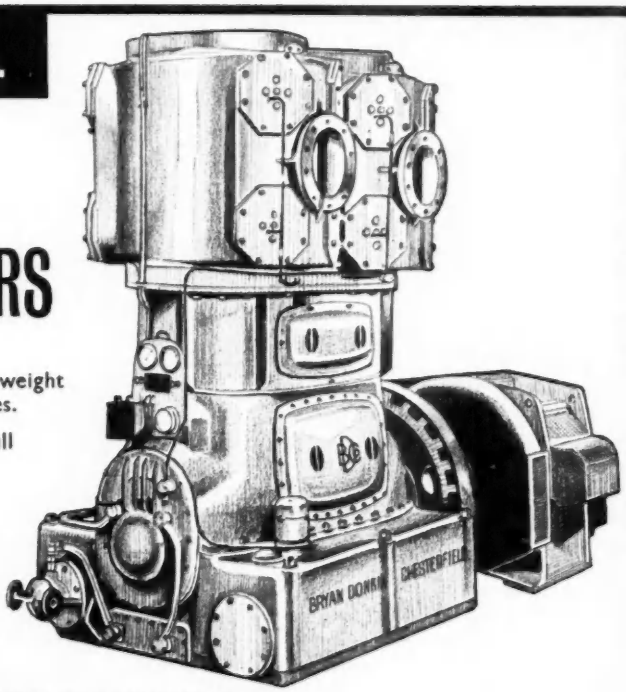

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Gas Journal

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CONTENTS

EDITORIAL COMMENT

Corrosion Problems in the Gas Industry - - - 257
Is Carbonisation Doomed? - - - - - - 258

SPECIAL ARTICLES

£5.6 mill. Credit Balance for Gaz de France in 1959 265
Cathodic Protection—Report of Joint Symposium of the I.G.E. and Corrosion Group of Society of Chemical Industry - - - - - - - 266
Se-Ridge Terminal for Domestic Gas Appliances - 268
The Derivatographic Investigation of Gas Purifying Materials. By M. Weltner - - - - 273
France Tackles Sulphur Problem in Lacq Natural Gas - - - - - - - - - 282

CHEMICAL AND BY-PRODUCTS SURVEY

Research in the Coal Tar and Benzole Industries. By D. McNeil and K. H. V. French. - - - 259

TECHNICAL RECORD

Press and Public Relations. By Robert Dunnett - 277

TECHNICAL DEVELOPMENTS SURVEY 284

NEWS SUPPLEMENT

Public Investment White Paper - - - - 286
Sahara Gas: 'Positive Policy Needed' says Peer - 286
A Far Thing - - - - - - - - - 286
8-hour Flare as Gas Ignites by Manhole - - 286
New Reforming Plant at Crewe - - - - 286
Altrincham Win North West Window Contest - 287
Southern Board Opens Central Heating Drive - - 287
Reds Make Big Oil/Gas Discoveries - - - 287
Ammonia From Natural Gas in Florida - - - 287
Weekly Statistics - - - - - - - 287
Clean Air Conference - - - - - - 288
Coming Events - - - - - - - 288
Board Acts on Noise Plea - - - - - 288
Payroll Theft - - - - - - - 288
Personal Notes - - - - - - - 288

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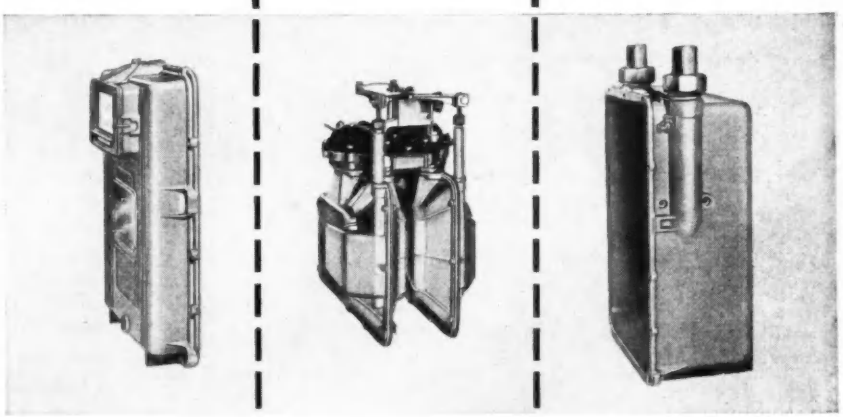

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Gas Journal

COKE OVENS • BY-PRODUCTS • CHEMICALS

Corrosion problems in the gas industry

POSSIBLY the most important technical conference of gas engineers held in this country during the year was the Joint Symposium of the Institution of Gas Engineers and the Corrosion Group of the Society of Chemical Industry which took place recently in Birmingham. In all there were eight papers, presented by specialists covering a very wide field. They ranged from theoretical considerations and fundamental principles, to practical methods of protection of metals, mainly iron, steel, copper, and aluminium, which are used in the construction of gasworks plant, mains and services, and consumers' appliances, both industrial and domestic.

The importance financially of avoiding or minimising corrosion in an industry such as our own, using as it does large qualities of the structural metals under more than normal corrosive conditions, may be visualised when authoritative sources estimated the cost of protective processes for steel in the United Kingdom during 1957 to be some £200 mill., of which about half was spent on painting. It needs but little imagination to realise that this figure only represents a small fraction of the total losses which corrosion brings in its train since, should structural failure occur, other additional costs which are largely unpredictable must be included to cover the loss of production and labour charges.

It was with this in mind that several speakers emphasised the importance of design. Although much can be accomplished for existing structures by the application of corrosion-prevention methods, is sufficient thought always given to the design of new plant and appliances to avoid facilitating corrosion? Any new construction must be given the most careful thought from its inception, and as Dr. W. H. J. Vernon remarked in the discussion, protection against corrosion should begin on the drawing board. Obvious factors are the avoidance of lodging places in which corrosive liquids or water containing corrosion-favouring bacteria may collect, or the unnecessary junction of electrically dissimilar metals such as bolts and rivets at points where galvanic action can take place. To illustrate this, many striking exhibits taken from industrial practice were on show at the conference.

Corrosion of structural metals in aqueous media, whereby part of the material is either lost or substantially weakened, may be said to derive from anodic and cathodic reactions. This can be brought about in various ways, by 'direct' chemcial attack, 'direct' electrolyses caused by external sources of current, galvanic attack by micro-cells made up by particles of electrically dissimilar metals, or by bacterial action. To cope with all these factors, at least a passing acquaintance with electrochemical and other theoretical principles is essential and the importance of this was emphasised in all the papers presented.

Those in the gas industry who have to concern themselves with corrosion problems vary greatly in their ability to grasp the theories involved or to apply such theories to the best practical advantage. It is therefore rare to find an engineer who is fully equipped to deal unaided with his own corrosion problems, which represent only one phase of his many activities. If the best results are to be obtained, he must work in close consultation with those specialists who, by their training and particular knowledge, are able to suggest the most effective and cheapest way out. At this symposium the findings of such specialists could be presented and discussed as the result of pure reasoning and in the light of practical experience.

How are future developments in the manufacture, distribution, and use of gas likely to help or impede the solution of our troubles and lessen the heavy cost of corrosion? One or two points emerge.

In the manufacture of gas, new processes of gasification under pressure are being developed, and such processes will enable us to use much smaller units of plant for a given output of gas. These smaller vessels and their supporting structures will expose a far smaller area of metal to corroding influences. On the distribution side, high pressures will mean smaller storage holders—the vulnerability to corrosion of present day large, low-pressure holders is a considerable anxiety to all station engineers. For the consumers, the gas will have much lower concentrations of sulphur, and corrosion caused by acid combustion products will be greatly lessened, or possibly be entirely absent. Gas of the future may well contain little or no CO_2, and less water vapour. These factors, coupled with developments in the use of plastics for the construction of service pipes, will doubtless contribute greatly to the elimination of corrosion in the domestic and industrial fields. On the other hand there are certain to be increases in underground sources of stray electric currents, and these will continue to present new problems.

On balance, however, it would seem that we in the

gas industry can reasonably expect less trouble with corrosion in the future, and for this boon we must be indebted to such bodies as the Corrosion Group of the Society of Chemical Industry. The Society aims to publish in the near future a very complete report on the symposium which will include all the papers, together with the many contributions to the discussion, both oral and written, which were a feature of the proceedings. Meanwhile we are reporting in this and in later issues a review of some of the highlights of the conference.

Is carbonisation doomed?

THE joint meetings of the Institution and the Coke Oven Manager's Association, held annually, always provide topics of considerable interest to the two sister industries, and the 1960 meeting held last week at Church House was perhaps of even greater interest than usual.

The paper, ' Coke Ovens, Retrospect and Prospect ' by Mr. D. T. Barritt and Mr. V. Robinson, not only proved to be a mine of information, but caused a certain amount of heart searching among the audience. Under this particularly pedestrian title, we were treated to a concise but complete history of the modern coke oven and its ancillary plant, and in the second part of what seemed to us an almost inspired treatise of the future viability of coke manufacture in its relationship to the production of iron and steel.

Interesting though the history of any technology may be, the future of a well-established industry such as that producing metallurgical coke, affects so many people that any threat to its existence is likely to inspire a discussion of greater interest than the evolution of so well-known a piece of plant as the coke oven.

It is instructive, however, to consider how the old ' bee-hive ' oven remained supreme for so long. For it was in this oven that all metallurgical coke was manufactured throughout the greater part of the 19th century, right up to the introduction of the ' patent ' oven from the Continent in the 1880's.

It is common knowledge that the ideas behind the smelting of iron ores by coke in a blast furnace and the early production of steel were due to British inventiveness. It seems, however, that they had allowed the initiative to pass from them. May this have been due to Britain having had the virtual monopoly of iron production for so long, and also the best coking coal then available? This may be so, but it is noticeable that the ' patent ' oven was developed from a British idea and all subsequent improvements worked out and pioneered by the German plant manufacturers.

It is disturbing, too, to realise that there have been no advances in the underlying design of the coke oven in the last 25 years, though there have been considerable improvements to detail. Are we, therefore, to infer that the coke oven as such has reached its optimum in design and cannot be improved upon? This we feel is a particularly important point, since within the last 25 years, conditions in both the labour and the industrial markets have changed out of all recognition.

As Dr. J. Burns, Deputy Chairman of the North Thames Gas Board, pointed out in the discussion that followed, the Beckton coke oven plant had been a complete success, but it had been very expensive to build and had no amenities for the operatives. Such operatives need to be really tough and willing to put up with far harder conditions of work than are now considered proper by either management or men.

Some form of mechanisation—automation would be asking for the impossible—must be designed to meet this need, not only in the coal and coke handling part of the process or the centralised control of the by-product plant, so well illustrated at the new plant at Murton, Co. Durham, but also in the running of the coke oven battery itself. In this respect, the cleaning of the oven doors is certainly the most difficult to mechanise.

Mr. Robinson pointed out that metallurgical coke was an expensive commodity to make, because modern plants on such lines would be expensive to build and also because suitable coking coals were running short. It was now necessary to blend the available coals to obtain a suitable raw material, and this in itself complicated the coke oven manager's task.

The great developments in blast furnace design and operation since the war have reduced the weight of coke now needed to produce a ton of pig iron and it is steadily falling, so Mr. Robinson saw very little future for the coke oven plant outside the steel works itself. ' Merchant ' plants, owned by the National Coal Board, supplying marginal quantities of coke would be unnecessary if this tendency persisted. It seems likely too, that if the value of surplus gas fell heavily, the highly, thermally efficient coke oven of today might be a thing of the past. Much simpler plants burning a greater proportion of their own gas would be quite satisfactory and the highly efficient regenerator could be replaced by a recuperator system. This would simplify plant design and so reduce the initial cost of construction.

But why use coke at all for the reduction of iron ore? Carbon in some form is undoubtedly better than hydrogen for this purpose since the latter generates steam as its final product which affects the iron. Natural gas if available cheaply and in large quantities might do the work equally well and a considerable amount of research has in fact been done on its use. Oil, too, sprayed from the tuyières with the blast is quite effective. We cannot help asking ourselves whether carbonisation as a process is perhaps doomed. The gas industry is steadily seeking other means of gasmaking and perhaps the iron smelters may be able to dispense some day with coke.

This whole conception we find a little frightening. Is Great Britain, possessed of some of the best coal in the world, going to be compelled to abandon its use as a major industrial fuel, simply because other countries with more easily handled fuels can undercut our production costs and so usurp our traditional markets? This may very well be the long term view but the large quantities of coal still carbonised by the coking industry—some 26 mill. tons in 1959—point to a reasonably high demand for metallurgical coke at present.

CHEMICALS AND BY-PRODUCTS

Research in the coal tar and benzole industries

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INDUSTRIAL research, unlike much of the more academic research carried out at universities, must aim at improving an industry's chances of operating profitably under the economic conditions likely to prevail in the future. Trends in the availability and quality of its raw materials, in the pattern of demand for the products and in the cost of ancillary raw materials, labour and utilities, will all contribute to the selection of the most attractive line of research for a particular industry. In order then to provide a proper frame within which the picture of current and future research in the carbonisation by-products industry should be viewed, it is necessary to discuss in general terms the structure and operations of that industry and the changes which have affected it in the past few years and are likely to affect it in the future.

Liquid by-products

The main liquid by-products of coal carbonisation are crude benzole and crude tar. The latter condenses from the gaseous products when they are cooled while the former is extracted from the cold gas by scrubbing or adsorption on charcoal. Crude benzole is almost completely volatile at 200°C., in contrast only about 50 to 60% of crude tar boils below 360°C. Separation of the benzole and the tar is not complete and a further small quantity of benzole is obtained during the distillation of the tar. Although the weight of tar obtained per ton of coal carbonised is about four times the weight of benzole obtained, the total values of the refined products obtained from the two by-products are similar.

The coal tar and benzole industries take these liquid by-products as and when they are produced, and process them separately to convert them into a range of products for which there is a commercial demand. Traditionally these industries are suppliers of intermediates to the chemical and allied industries; in fact it is not unrealistic to contend that their plant and processes have been developed primarily to produce benzole, toluole, xyloles, naphthas, naphthalene, anthracene, phenols, cresols and pyridine bases as solvents and chemical intermediates for other industries. These products, however, make up only a relatively small proportion of the crude benzole and crude tar and, in their production in the purity demanded by the consumer, there is inevitably produced much larger amounts of the so-called bulk products—motor benzole, tar oils of various boiling ranges and pitch—the profitable disposal of which is of paramount economic importance.

The development of new uses for the purer products must be mainly the function of the chemical and allied industries; research in the tar and benzole industries has concentrated on devising the cheapest methods of recovering these substances in the amount and quality required.

The initiative in developing markets for the bulk products has had to come and must still come in the future from the tar and benzole industries themselves and, in fact, it is only their success in the past in promoting motor benzole, road tar, coal tar fuels, creosote for timber preservation, pitch for briquetting and similar bulk product outlets which have enabled them to continue as viable and flourishing industries.

Changes in the economic climate and in the technique of other industries, can drastically alter the supply and demand for coal carbonising products, and since the carbonisation by-products industries have no control over the quantity or quality of their raw materials, they are peculiarly vulnerable to such changes. For example, two recent developments—the cessation of motor spirit production by the hydrogenation of creosote and the reduction in demand for coal briquettes—have faced the tar industry with the problem of finding alternative outlets for large amounts of tar oils and coal tar pitch. On the other hand the demand for naphthalene and benzene by the synthetic chemicals industry has increased at an unexpectedly rapid rate, and this has confronted the tar and benzole industries with the different type of problem of finding economic means of greatly increasing the extraction rate of these components. In the case of benzole the situation is being met by increasing the production of pure benzene at the expense of motor benzole; in the case of naphthalene every effort is being made to increase the extraction rate, but even so, it appears that the shortage will persist for some time to come. These unpredictable fluctuations in the demand for carbonisation by-products are reflected in the relatively short term nature of many of the research projects undertaken.

Research activities in the coal tar and benzole fields follow then three main lines. The first of these comprises investigations aimed at increasing our knowledge of the chemical constitution and physical properties of crude benzole, crude tar, and products derived from them. The

CHEMICALS AND BY-PRODUCTS

second broad category of research work includes investigations into the industries' current processes with the objective of improving the efficiency, reducing the cost and improving the quality of the products of these processes. In this field must be included the investigation of novel techniques for extracting and refining established products. These studies may be aimed at maintaining or expanding an already developed market or of developing new outlets.

Although the genesis of the liquid products of carbonisation and the effect of carbonisation conditions on their chemical composition are somewhat academic problems they are of importance for the light they can throw on the structure of coal and the possibilities they may disclose of improving by-product yield and quality by minor variations in carbonisation technique.

The comparison of the composition of benzoles and tars formed by carbonisation of coal at temperatures ranging from 450°C. to 1,200°C. has enabled some of the more important reactions occurring during the carbonisation process to be defined although there is still considerable controversy about the nature of the primary products formed when coal is pyrolised and whether these represent fragments of the cellulosic and lignin residue or are derived from the resins, proteins and other minor constituents of the original plant debris.

Question unsolved

The question as to whether all the compounds identified in tar can be attributed to the secondary reactions occurring as the primary products traverse the hot coke or char, or whether some of them represent fairly massive fragments of the original coal structure remains unsolved. It is clear, however, that as the carbonisation temperature is raised and the carbonisation time increased, at least within the temperature range 600° to 1,200°C., the liquid pyrolysis products become less paraffinic and olefinic, phenolic compounds are dehyroxylated to aromatics and the aromatics dealkylated and condensed to fused ring systems. In this field the work of Mantel and Hansen[1], Gruzdeva[2], Rosendahl[3], van Krevelen and his co-workers[4, 5], to mention only a few, may be cited, and undoubtedly research in this interesting field will proceed with increased tempo in the future.

The simpler nature of crude benzole compared with coal tar makes its mode of formation more amenable to investigation. The advent of gas-liquid chromatography has made it possible to design apparatus that will perform the necessary analyses of the benzole in the gas produced during a coking cycle. The construction of an experimental coke-oven unit by the British Coke Research Association[6] at Chesterfield has provided the ideal plant for the investigation of the benzole hydrocarbons produced during the carbonisation of a coal charge.

By carrying out analyses at intervals during the carbonisation cycle a picture has been obtained of the changes in the composition of benzole in the gas as the carbonisation proceeds. From the results obtained the following conclusions may be drawn:—

1. The concentration of benzene in the gas gradually increases during the greater part of the carbonising period, but falls off rapidly just prior to the completion of the carbonisation.

2. The concentrations of toluene and xylenes rise to maxima in the early part of the carbonising period and then fall off gradually during the remainder of the period.

3. The changes in the concentration of thiophene follow a similar pattern to that of benzene.

4. The concentration of *cyclo*pentadiene follows a similar pattern to that of benzene.

5. Paraffins and naphthenes are evolved in the first part of the carbonising period. There are no paraffins or naphthenes in the gas evolved in the second half of the carbonising period.

6. The changes in the concentration of carbon disulphide are similar to those for the paraffins and naphthenes.

To obtain more basic information on reactions occurring during coal carbonisation, laboratory experiments are being conducted to investigate the volatile materials evolved when coal is heated to various temperatures and the changes these materials undergo when subjected to pyrolysis under conditions similar to those existing in a coke oven. It has been found that benzene and toluene are evolved in small quantities when coal is heated to only 150°C. At temperatures as low as this, breakdown of coal molecules can hardly be visualised and evolution of hydrocarbons held within the coal structure seems a more likely explanation.

When mixtures of the lower aromatics, paraffins and napthenes are subject to pyrolysis below 500°C. little decomposition occurs, but at higher temperatures preferential destruction of the non-aromatics takes place. Under the conditions used in the laboratory *n*-hexane and methyl-*cyclo*hexane were almost completely destroyed at 750°C., but only 20% of the benzene had been removed. At temperatures above 900°C. all the benzene and toluene were destroyed. From these experiments it would be expected that unless the residence time is very short, any hydrocarbons that pass through coke at over 900°C. in the coke oven will be decomposed.

It is hoped that further work on these lines will provide information on the reactions occurring in different parts of the coke oven. From these data it may be possible to predict the conditions required for the production of aromatic hydrocarbons free from non-aromatics.

Of more immediate importance to the industry is the chemical assay of benzoles and tars made by different industrial processes, particularly the newer processes of low temperature carbonisation and oil gasification. Crude benzoles produced by the Segas and Onia-Gegi oil-gas processes[7] have been shown to be highly aromatic in nature and somewhat similar to benzole produced from horizontal retorts. The sulphur content, as would be expected, is a function of the sulphur content of the oil feed. The crude benzole produced by the Lurgi complete gasification process of the type being installed at Westfield[8] is a poorer quality material containing only about 75% of aromatic hydrocarbons and up to 15% of unsaturated hydrocarbons[9]. The oil hydrogenation process for gasmaking yields benzole that consists almost entirely of benzene and when a desulphurised feedstock is used little refining other than distillation is required[10].

McNeil and Vaughan[11] have published comprehensive assays of a number of continuous vertical retort tars and coke oven tars, and this work has been followed up at the Coal Tar Research Association by similar studies of intermittent vertical retort tars, carburetted water gas tars, oil gas tars and low-temperature tars made by complete gasification and fluid bed carbonisation. Gomez and his co-workers at the U.S. Bureau of Mines[12] have published a comprehensive review of the literature on the formation, properties and constitution of low temperature tars and Australian workers[13] have given data on the tars produced by pilot plant carbonisation of coal over the temperature range 600°C. to 1,000°C.

These analyses have focused some attention on the cor-

relation between the chemical and physical properties of coal tars and a statistical correlation of the properties of a wide range of tars, including blended tars, has recently been carried out. This showed that the specific gravity of the dry tar was the best indication of its chemical type, correlating with its aromaticity, phenol content and content of benzene insoluble resins; there was however, no correlation between the chemical nature of the tar and its rheological properties or its thermal stability. On the basis of this work a characterisation index for tars based on the level of the specific gravity, the phenol content of the lower boiling oils and the benzene insoluble content is proposed[14].

Fine structure

Research work has also continued on the fine structure of tar oils and tar products. It is sad to record that Kruber, who devoted a long and intensely active life to the separation and identification of the individual components of coal tar died at the age of 70 in 1958, but his school now headed by his pupil Oberkobusch is continuing its work. In addition to the work published by Kruber and his co-workers mention may be made of the analysis of the higher boiling tar acids by Dean et al[15], of pitch coking oils by Harris and his colleagues[16, 17], of the pyridine bases by Nisbet and Pryde[18], and by Arnall[19] and of a naphtha by Butler[20], as indicative of the detailed investigations of tar fractions which have been published in the past few years.

Such detailed analysis can be greatly speeded up by the use of gas-liquid chromatography and in the development of the technique the benzole and tar industries have made important contributions both on the theoretical and practical sides. The work of Scott[21], Grant and Vaughan[22], and Dupire[23] deserves mention here. This technique has recently been applied to the quantitative analysis of high boiling tar oils and complex mixtures of tar acids and tar bases, and has been employed as an analytical tool to monitor changes in the composition of benzole during the carbonising cycle.

These developments and the construction of super efficient capillary columns are current research projects which should, in the future, result in a great increase in our knowledge of the nature and distribution of the chemical components of tars and benzoles.

Molecular weight

The study of the higher molecular weight end of pitch presents a more difficult problem since the usual techniques are not applicable to these involatile, thermally labile, resinous materials. The main contribution in this field has come from the work carried out by Wood and his colleagues at the Coal Tar Research Association[24, 25] who have determined molecular weights and average structural formula for pitch fractions.

The evidence which they adduce suggests that the pitch resins are less highly condensed than might be expected by analogy with the lower fractions, and consist mainly of ring-chain compounds consisting of relatively small condensed aromatic nuclei joined by single bonds or through short methylene bridges. The strong association of these molecules into 'swarms' may be due to attraction between polar and polarisable molecules or to steric inter-entanglement. The conception of pitch as a system in dynamic equilibrium consisting of such 'swarms' in a randomly continuous medium of lower molecular weight components is preferred to the older conception of it as a micellar colloid system.

Tars and pitches are approximately Newtonian in their flow properties so that their rheological behaviour over a wide temperature range is defined by the viscosity at any temperature and a temperature/viscosity coefficient. Recently Frank and Wegener[26] have shown that the Walther equation—log log (kinomatic viscosity + .8) = $K_1 + K_2$ log T—holds for high temperature tars, pitches and tar oils. and moreover that the value of K_2 is simply related to the amount of toluene insoluble matter in the material. It has since been shown that this relation holds for all straight-run and thermally-polymerised coal tar pitches.

Attention is being increasingly directed to the study of the 'solid' properties of pitch, and an excellent review of both the viscous and brittle properties over a wide range of stress, strain and temperature has been presented by Thrower.[27] Berneis and Wood[28] have shown that, at temperatures of 60 to 70°C. below their softening point, pitches behave as organic glasses exhibiting at this critical temperature anomalies in their physical properties. Data on the density, specific heats, latent heats and thermal conductivities of tars and tar products including some useful correlations have recently been presented by Briggs and Popper.[29, 32]

Hydrorefining of benzole gives the maximum possible yield of 'white' products with excellent desulphurisation, but for pure benzene production a difficulty may be introduced due to the formation of saturated non-aromatic hydrocarbons that are difficult to separate from benzene by distillation. These may be formed from unsaturated hydrocarbons or by hydrogenation of aromatics. Anticipation of the difficulties in the production of pure benzene from hydrorefined material may well account for the reluctance of some benzole refiners to instal hydrorefining equipment.

CHEMICALS AND BY-PRODUCTS

Udex process

The Udex process[33] in which the aromatic hydrocarbons are extracted from the non-aromatics by aqueous diethylene glycol, was developed for the extraction of aromatic hydrocarbons in the petroleum industry. The process, has, however, been successfully applied to the purification of benzene after hydrorefining.

At the Clairton plant of the United States Steel Corporation, the crude benzole is hydrorefined, subjected to Udex extraction and finally fractionated into benzene, toluene and xylene. The pure benzene has a crystallising point of 5.48°C.—99.91% benzene—and has a total sulphur content of only 1.4 ppm. w/w.

In the search for a method of refining which would yield high purity benzene even when paraffins and naphthenes were present in the starting material, the treatment of a crude benzene fraction with chlorine was investigated.[34] Thiophene and unsaturated hydrocarbons react readily with chlorine. Paraffins and naphthenes will also react if peroxides are present or they may be induced to react by irradiation with ultra-violet light.[35] The product from such treatment may be freed from chlorinated compounds by distillation.

A pilot-plant operated by Benzole Producers Ltd. demonstrated that an excellent yield of the available benzene could be obtained. Even from crude benzene fractions taken from low-gravity gasworks' benzoles, products with crystallising points above 5.4°C.—99.8% w/w benzene—were obtained. The sulphur present as thiophene in the product was less than 2 ppm. w/w. The paraffins, naphthenes and olefines are converted to mixtures of mono-, di-, and poly-chlorinated hydrocarbons. The thio-

CHEMICALS AND BY-PRODUCTS

phene is converted mainly to a mixture of 2-chlorothiophene and 2:5 dichlorothiophene.

The quantities of these chlorinated compounds produced may be considerable, particularly if low specific gravity material is treated. An outlet for these materials would therefore be required if the process is to be operated economically.

Prior to 1958 Benzole Producers Ltd., the Coal Tar Research Association and Newton, Chambers & Co. Ltd. had been working independently on crystallisation processes for the purification of benzene. In 1958 it was decided that a joint research project should be undertaken by these three organisations with the object of developing as rapidly as possible a crystallisation process for the production of pure benzene. All the impurities in benzene except thiophene can be removed to a low level by such a process. Thiophene forms solid solutions with benzene and must be removed by some other treatment such as hydrorefining or acid washing.

Mixing with brine

After a year's work a suitable process was developed and details of operation and economics have been published.[36] A benzene fraction containing not less than 90% benzene is mixed with brine cooled to an appropriate temperature. A high proportion of the benzene crystallises and is subsequently separated from the brine by centrifuging. Additional purification may be obtained by spraying the crystals on the centrifuge with brine at such a temperature that a small proportion of the benzene melts and washes away some of the entrained mother liquor.

The yield and quality of the product will depend upon the operating conditions and particularly upon the efficiency of the centrifuge. A typical example of the process in which the centrifuge was capable of reducing the entrained mother liquor to 3% would be 90% yield of benzene with crystallising point 5.4°C. from a feed with a crystallising point of 3.4°C.—about 96% benzene.

Benzene for certain synthetic processes is required to be of high purity, particularly with regard to total sulphur content. Thiophene is the most difficult sulphur compound to remove to this low level. Successful removal can be achieved by batch treatment with sulphuric acid, but several treatments with 98% w/w acid are usually required.

Column type units

Great economy in time and in the space required for the plant is achieved by the use of column type continuous acid-washing units. These have been developed as a result of research by the chemical engineering companies. Pulsed columns containing packing[37] or plates[38] have been applied to benzole treatment. This type of equipment is certainly not inferior to batch equipment with respect to yield, acid consumption and thiophene removal and has all the usual advantages of a continuous process.

Stabilised sulphur trioxide is an obvious alternative to sulphuric acid for thiophene removal. Experiments with solutions of thiophene in benzene have shown that the thiophene sulphur can be reduced to less than 1 ppm. w/w by treatment with liquid sulphur trioxide. The presence of appreciable quantities of unsaturated hydrocarbons reduces the effectiveness of its removal substantially. A preliminary treatment to remove the bulk of the unsaturated hydrocarbons is therefore desirable. The reaction between thiophene and liquid sulphur trioxide is rapid and the reaction products, presumably thiophene sulphonic acids, are dissolved or dispersed easily in water.

The speed of the reaction between liquid sulphur trioxide and thiophene led to the development of a continuous method of benzole treatment with this reagent[39]. The benzole and liquid sulphur trioxide are mixed in the correct proportions in a venturi mixer. The mixture is passed through a tube to provide the necessary residence time for the reaction to proceed to completion and thence to a water washer and neutralisation stage. Redistillation of the treated benzene is not usually necessary.

A feature of the tar industry during the past 20 years has been the replacement of batch pot stills by continuous stills and much investigational work by the plant contractors has gone into the design and instrumentation of continuous plant. It has become clear that the coking-up of such plants can only be avoided if the heat flux is kept below a critical level and the tube wall temperature below a certain value. Operation of the heating coil under pressure to minimise vaporisation, flue gas circulation, and twin-furnace coils are features of modern plants which ensure these desired conditions. The entrained water content of tar can be critical for the satisfactory operation of these plants and some economic system of mechanically dewatering crude tar, not only to improve the operational stability of the plants but also to remove the bulk of corrosive ammonium salts, would be a considerable advance. Centrifugal separation[40] and pressure settling have been advocated, but neither is universally applicable or economic.

The usual process for the recovery of tar acids consists in extracting a phenol containing fraction with 8 to 10% aqueous caustic soda, steaming or solvent extracting the sodium phenate to remove tar bases and neutral oils, decomposing the purified phenate with a gas containing carbon dioxide, separating and drying the crude tar acids, fractionating the crude tar acids, and recovering the caustic soda by recausticising the sodium carbonate liquor. The replacement of this rather complicated sequence of processes by a simple solvent extraction process is a challenge to the research side of the tar industry.

Not satisfactory

Recent efforts to solve this problem have involved the use of aqueous sodium carbonate under pressure[42], extraction with aqueous monoethanolamine[43], with tar base sulphate solutions[44], with aqueous triethylene glycol[45] and with sodium phenolate solution[46].

None of these, despite the claims made for them, are a satisfactory alternative to the traditional method. The solvents are not sufficiently selective and do not distinguish between the tar acids and tar bases with the result that the extracted phenols are contaminated with relatively large amounts of neutral oils and bases. The former can be substantially removed by extracting with a light petroleum, but this involves another contacting and solvent recovery stage; a more serious obstacle is that no satisfactory method has been developed for the separation of the tar acids and bases.

The recovery of maximum yields of pure naphthalene from coal tar is a current pressing problem in the tar industry and one which appears likely to become more acute. Low naphthalene recovery is due to two main causes—inadequate primary fractionation leading to the presence of a relatively high proportion of naphthalene in the naphtha and wash oil fractions which are not processes for naphthalene recovery, and the presence of about 20% of naphthalene in the drain oils which are disposed of as creosote. The former loss can be minimised by taking a wider naphthalene oil cut, but this reduces the crystallising point of this fraction and increases the loss of naphthalene in the

drain oils; it can also be increased by recycling drained oil with the tar to the primary distillation process with appropriate alteration of the take-off points on the fractionation column[47].

The loss of naphthalene in the drain oil can be reduced by refractionating this oil or refrigerating to obtain a second crop of crystals. Rose and Sweeney[48], and McNeil[49] have studied the upgrading of oils of relatively low naphthalene content by fractional distillation and the latter gives a method for estimating the distillation efficiency required to recover a specified amount of the naphthalene at a given level of purity.

Methods of recovery and purifying naphthalene from naphthalene oils have radically changed in the past few years. Atmospheric cooling in open pans has given place to continuous cooling in enclosed, stirred crystallisers; whizzing and hot-pressing of crude crystal naphthalene is increasingly being replaced by upgrading by centrifugal washing or continuous fractionation.

Sweating process

A recent development is a 'sweating' process and the Rutgerswerke[50] A.G. have developed a process in which the naphthalene oil is crystallised by mixing with a large volume of cold water and the slurry centrifuged.

All these changes in operation, particularly when combined with refractionation, refrigeration or the recycle of drain oils will affect the nature of the residual impurities in the final product.

The selection of the best sequence of operations for naphthalene recovery and the identification and elimination of deleterious impurities from the final product will provide important projects for future research. Thionaphthene removal by catalytic hydrorefining and by treatment with metallic sodium have already been the subjects of fairly exhaustive investigation.

The separation of anthracene, phenanthrene and carbazole, the main components of the solid phase which crystallises from coal tar anthracene oils continues to provide a subject for investigation as the large number of recent patents on this topic shows[51].

Separation difficult

The demand for pure pyridine, α-picoline for vinylpyridine, β-picoline for nicotinic acid and γ-picoline for isonicotinic acid hydrazide has focussed attention on the separation of these components of coal tar bases. The lowest two members of the series, pyridine and α-picoline are relatively easily separated by fractional distillation, but the separation of the other picoline isomers from their mixture with 2:6-lutidine is not so simple. Much work has been done on this problem and a variety of methods claimed in patents.

These range from fractional crystallisation of the salts with inorganic and organic acids, selective complex formation with a wide range of inorganic and organic reagents and azeotropic distillation. The last method, very high efficiency fractionation of the water azeotropes, is that currently used in industrial practice, but it is expensive by virtue of the large amount of steam used. Prior separation of the 2:6-lutidine by extraction with neutral nickel sulphate solution is one improvement which has recently been developed[52].

Nickel salts form complexes which are stable at ordinary temperatures, but readily decomposed on boiling with tar bases which are unsubstituted in the 2 position, but not with bases like α-picoline or 2:6-lutidine which contain substituents on a carbon atom adjacent to the nitrogen.

The products prepared from crude benzole for use in the synthetic chemicals industry include *cyclo*pentadiene for the manufacture of Aldrin and Dieldrin, benzene for nylon, dodecylbenzene, phenol, aniline, benzene hexachloride and maleic anhydride and toluene for toluidines and polyurethanes. Indene is not separated in a pure state from crude benzole, but it is concentrated so that it may be used for resin formation.

CHEMICALS AND BY-PRODUCTS

Since the end of world war II there has been a very marked change in the relative proportion of the products made from crude benzole. There has been a steady decline in the amount of motor benzole and a roughly corresponding increase in the amount of pure benzene produced.

The swing to pure benzene production was anticipated, and during the last ten years progressively more research effort has been applied to the development of improved methods of refining to produce pure benzene. These processes are mainly directed at the removal of saturated non-aromatic hydrocarbons from benzene. The quantities of these objectionable impurities to be separated from benzene will be increased if coke oven crude benzoles are hydrorefined, if gasworks benzoles are used for pure benzene production or if the throughput of coke ovens is decreased. The introduction in Great Britain of a minimum crystallising-point specification of 5.2°C. for benzene—nitration grade—in the 1960 N.B.A. specifications has also emphasised the importance of removal of non-aromatic hydrocarbons since this crystallising point is equivalent to a purity of 99.5% w/w benzene. There is also a limited demand for benzene with a crystallising point of 5.35°C. (99.7% w/w benzene).

Analytical methods

The refining methods already discussed can yield benzene of very high purity, but special analytical methods are required for the detection of the trace impurities remaining. Much research work has been concerned with the development of analytical methods for the determination of small quantities of total sulphur,[53, 54, 55] elementary sulphur,[57, 58] thiophene,[56, 57] and carbon disulphide.[57]

Research into this important outlet for the bulk products of tar distillation takes two main forms. The establishment of the best conditions for using road tar in surface-dressing, and as a binder in tarmacadam owes much to the work done by the Road Research laboratory of the D.S.I.R. supplemented by experimental programmes conducted by the major tar distillers. This work has established the correct rate of spread, the correct viscosity under prevailing conditions and so on for the surface dressing of roads with tar, and has likewise defined the correct grading of aggregate, amount of binder, and conditions of laying for making the best tar carpets and base courses. It has become clear that weathering of road tar is much more rapid and serious in open-textured than in close-textured compositions, and a feature in recent years has been the development of dense tar surfacings for heavily-trafficked roads, airfields, 'bus depots, and other locations where resistance to heavy loads and oil spillage is important.

The mechanism of weathering of road tar in open and medium textured carpets is not yet understood, and this fascinating, but difficult topic must continue to attract attention. The R.R.L. work shows that, particularly with road binders derived from continuous vertical retort tar, oxidation plays an important part; this factor is perhaps less

CHEMICALS AND BY-PRODUCTS

important with the road tars used on the Continent and in America, which are mainly derived from coke oven tars and here there is some evidence from laboratory, but not full scale tests, that the boiling range of the oils and the ratio of heavy oil to pitch are significant.

One recent promising development of which much more will be heard in the near future is the production and use of tar-bitumen mixtures. These appear to possess some of the advantages of bitumen, but give a non-skid surface throughout the life of the road surface.

Coal tar fuels are now burned at a rate of over a mill. tons per annum, and there are comparatively few problems outstanding in their use. In open-hearth furnaces the problem of 'iron oxide fume' experienced with liquid fuels, including coal tar fuels, is still under investigation, and there is some evidence to suggest that the life of roof refractories is somewhat shorter when the furnaces are operated at the higher output rate which can be achieved by the more highly emissive coal tar fuels. The replacement of silica bricks by chrome-magnesite bricks has in several cases, considerably extended the life of roof refractories in open hearth furnaces fired by these fuels.

Their use for firing gas turbines is the subject of current research work, and it has been shown that such fuels are satisfactory provided the sodium content is reduced to under 50 ppm.

No major changes

There has been no major changes in the technique of impregnating timber with creosote over the past decade nor is any radically different or more effective method likely. Long term service tests with wood impregnated with creosote, oil soluble preservatives and water-borne preservatives are in progress in many countries, and the results to date tend to confirm that for outdoor use, where insect and fungal attack is likely to be particularly serious, creosote alone or with a small addition of pentachlorphenol are the most effective agents. Tests are also in progress to find the most effective preservative against *teredo* and *limnoria* attack on marine timber; here again coal tar products are displaying outstanding efficiency.

Among the new profitable uses for pitch may be mentioned the production of pitch impregnated fibre conduits, the production of special enamels for the protection of underground pipelines against corrosion, the development of pitch polymer compositions, especially pitch epoxy resin products, as special adhesives and anti-corrosion coatings and the use of pitch/asbestos mixtures as cheap thermoplastic moulding compositions. Research work into the optimum formulation of such special pitch compositions and more fundamental studies on the correlation between the properties of these materials and the properties and amounts of their components is being undertaken by a number of organisations in Great Britain and abroad and is likely to be an important field for future research.

There is an increasing demand for pitch as a binder for Söderberg self-baking electrodes and it appears, from the results at present available, that thermal polymerisation of pipe still coke oven pitch is the most attractive method of meeting this demand. Recently Thomas[59] has made an excellent survey of this outlet for pitch and suggested the lines which future work must follow.

New outlets for creosote are a much more difficult problem. Increasing attention is being directed to the thermal or catalytic cracking of tar oils, but the results so far suggest that at atmospheric pressure the main effect is to gasify the paraffins, convert a minor amount of the phenolic components to hydrocarbons, and effect very little alteration to the aromatics. High temperature cracking under hydrogen pressures up to 100 atmospheres causes more deep-seated alterations and the phenolic components can be substantially dehydroxylated and the aromatics dealkylated to a considerable degree. However, under present conditions such a cracking process would show little economic attraction, and attention is now being concentrated on the separation of tar oils into paraffins, aromatics and tar acids by solvent extraction, followed by the dealkylation of the tar acid and aromatic fractions separately and the utilisation of the paraffins as a diesel fuel.

Disappointing results

The catalytic cracking of the higher boiling tar acids to phenol and cresols has been the subject of much work in the past, but so far the results have been comparatively disappointing. At best, conversions of 40 to 50% are achieved with yields of about the same order. The competing reactions of dehydroxylation, leading to neutral hydrocarbons, isomerisation and disproportionation, leading to the production of polyalkyl phenols, cannot be prevented. The investigation of new catalysts and conditions for the economic conversion of higher boiling tar acids to the more marketable lower boiling isomers will doubtless continue in the future.

The dealkylation of the lutidine and collidines is a more attractive possibility although more drastic conditions are required, competing reactions are, thermodynamically, less likely, and it is expected that laboratory and pilot plant studies in this field will, in the future, lead to industrial processes. Work is also in hand on the separation and utilisation of individual components of the high-boiling tar acids and recently the higher boiling tar bases have been shown to have a potential use as a vapour phase corrosion inhibitor.[60]

Outlets lacking

A number of polycyclic aromatic hydrocarbons—naphthalene, anthracene, phenanthrene, acenaphthene, fluorene, chrysene, pyrene and fluoranthene—could be isolated in a relatively pure state from high temperature tar, but, except for the first two, they have no major outlets. Small amounts of the others are extracted and sold to the dyestuffs industry and as laboratory chemicals. The large scale utilisation of these major components of high-temperature tar is a challenge which has faced both the chemical industry and the tar industry for the past 50 years, but one which has so far not been met. Sporadic work on the chemistry of fluorene,[61] the conversion of phenanthrene to diphenic acid,[62] the utilisation of acenaphthene as an intermediate for plastics,[63] have been published, but none of these researches have resulted in commercial processes. Speculative research of this nature is certain to continue in the future although, judging by the results over the past years, the prognosis for its industrial application must be regarded as unfavourable.

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£5.6 mill. credit balance for Gaz de France in 1959

THE Administrative Council of Gaz de France has just published its annual report for the year 1959*. Financially, a credit balance of 77,209,000 (old) francs (say £5.6 mill.) is shown.

The major preoccupation of Gaz de France during 1959 has been to put natural gas from Lacq rapidly at the disposal of a growing number of consumers. Here, production was increased to 145% of that of the previous year and reached half-way towards the optimum level forecast for 1962.

During the year effort has been directed to the transport and distribution of this gas to regions beyond the south-west. Many localities in the western regions are already served.

The artery directed towards the east connects Lacq with localities situated between Angoulême and Dôle and the central artery has fed, two weeks before schedule, the central electric power station of Montreau and the gas cokerie of Alfortville.

In short, by the end of 1959, the major portion of the natural gas network was in service.

Among the purchases made by Gaz de France, those of natural gas increased from 950 to 1,700 mill. thermies (say, 38 to 68 mill. therms), or an increase of about 80% over 1958.

Consequently the quantity of coal carbonised continued to decrease and 42 existing works were shut down. Other works were converted to propane-air, pure propane or gas made by cracking light oils.

There was an overall reduction of coke production of 10%.

Purchases of gas from coke ovens of collieries and steelworks have steadily grown and new mains have been laid, notably in the industrial Ardennes. A considerable increase was realised in purchases of refinery gases in the regions of Rouen and Marseilles.

Of the total emission, the proportion of natural gas and petroleum gases grew from one-fifth to one-quarter from 1958 to 1959.

The number of consumers increased by 145,000 in 1959 as against 130,000 in 1958 and 115,000 in 1957.

Domestic consumption, in spite of the exceptionally high temperatures of 1959, increased by 1.1% over 1958.

Total sales of gas show an increase of 1.9% over 1958.

The utilisation of natural gas and petroleum products had a considerable influence, during the course of 1959, on the production of gas In the course of that year gas from Lacq arrived at the ends of three arterial mains ending at Paris, Lyons and Nantes respectively.

Notably at Nantes, the completion of two reforming units with a capacity of 100,000 cu. m. (say 3½ mill. cu.ft.) per day put an end to the carbonisation of coal early in 1959; the demolition of the retort benches is proceeding.

On the other hand, the new battery of coke ovens has been brought into operation at Strasbourg. This is probably the last coal carbonising plant which will be constructed by Gaz de France.

Two new gasholders and a number of reservoirs for the storage of propane and butane have been constructed. The underground storage at Beynes passed, during 1959, from the period of experimentation to that of full exploitation.

In November 1959 the total volume of coke oven gas stored at Beynes reached 237,000,000 cu. m. (837 mill. cu.ft.) permitting daily withdrawal of the order of 1,500,000 cu. m. (53 mill. cu.ft.)

Investigations of the geological structure of Vernon, with a view to the eventual underground storage of natural gas, were resumed in 1959, together with the systematic study of the possibility of storage in caves of propane and butane in the south-east of France.

Finally, theoretical and laboratory work on the possibilities of underground storage of liquid methane at −160°C have given encouraging results.

* *Journal des Industries du Gaz*, Aug.-Sept.

Cathodic protection

THEORIES, PRINCIPLES, AND PRACTICAL APPLICATIONS

The selection of the eight papers on the protection of gas plant and equipment from corrosion which were presented at the Joint Symposium of the Institution of Gas Engineers and the Corrosion Group of the Society of Chemical Industry, showed a wise judgment in that the subject was well dealt with from both theoretical and practical viewpoints.

Indeed, the outstanding impression was the growing conviction, as one paper succeeded another, that, in matters concerning corrosion, interdependence of theory and practice is absolutely essential before any real success in combating the problems can be expected.

The complexity of the chemical and physical principles involved, and the variety of special problems encountered in practice are so great, that it is not unreasonable to suggest that every case needs some degree of expert knowledge, so that it has become a matter of necessity for any gas engineer who is called upon to deal with corrosion problems to do so in collaboration with consultants or firms having specialised knowledge and experience.

TWO of the papers were outstanding in that they stressed the importance of the rôle of theoretical knowledge in the solving of such problems. Dr. T. P. Hoar (Department of Metallurgy, Cambridge University), who opened the reading session, stated: 'I, for one, am finding more and more that the solution of utterly practical problems is nearly always immensely facilitated by the knowledge and use of complex, even abstruse, electrochemical theory. If, therefore, I can convert even one practical man from further repetition of the easy nonsense "It may be all right in theory, but what earthly good is it in practice" to a proper study and use of theory, I shall feel that the present lecture is not a waste of time.'

Mr. K. A. Spencer, (Spencer and Partners, London) in his paper 'Principles and Applications of Cathodic Protection,' gave a masterly resumé of those principles of electrochemistry which relate to the phenomena of corrosion, with particular reference to practical methods of dealing with the problems involved. It is mainly on this latter paper and on the discussion which followed, that the summary which follows is based.

Corrosion of metals involves the loss of metal, either general or localised, which is brought about by chemical reaction of the metal with the non-metallic substance of its environment. For the purpose of the present discussion, consideration is given only to reactions of solid metals in aqueous environment. Corrosion may be described in electrochemical parlance as the loss of positive metal ions from the metal surface.

The tendency of a metal to lose positive ions to an electrolyte in which it is immersed, results in parts of the parent body acquiring a negative charge; an equilibrium potential is established between the metal and electrolyte, at which the rate of loss of ions from the surface is equal to the rate at which they are drawn back by this negative potential. This potential depends upon the nature of the metal and its surface, and the nature and concentration of ions in the electrolyte.

When a metal is immersed in a normal concentration of its own ions, it reaches a potential which determines its place in the electromotive series, which is a list of metals arranged in order of the magnitude and polarity of their potentials, quoted with reference to a hydrogen electrode, and ranging from -3.02 V. for lithium, to $+1.42$ V. for gold. The series must, however, be used with reservation when applied to corrosion problems, because the presence of surface films, and the fact that metals are seldom used in solutions containing large concentrations of their own ions, means that the potentials are considerably modified in practice, and, in certain circumstances the order of two metals in the series may be reversed.

When two areas of a continuous metallic structure have different equilibrium potentials, there is a resultant e.m.f. equal to the algebraic sum of the two interface potentials and the junction potential between the two metal areas, tending to cause the flow of an electric current round the circuit formed by the metal and the electrolyte. The areas of metal surface from which positive ions leave to enter the electrolyte are known as anodes, and those to which positive ions are attracted are known as cathodes.

Cathode reactions are as follow: First, when oxygen is present, it is absorbed, and electrons are transferred by the reaction

$$2H_2O + O_2 + 4e = 4OH^- \quad . \quad . \quad . \quad . \quad . \quad (1)$$

Secondly, when oxygen is absent and the electrolyte is neutral, or near neutral—in acidity—a reaction enabling charges to be transferred across the cathode surface cannot occur at an appreciable rate, and, owing to the presence of a layer of hydrogen which is built up at the cathode surface, corrosion virtually ceases.

With an acid electrolyte, the concentration of hydrogen ions is high, and charges are transferred by the reaction

$$2H^+ + 2OH^- + 2e = H_2 + 2OH^- \quad . \quad . \quad . \quad (2)$$

In both reactions the liquid near the cathode surface becomes more alkaline, and, in reaction (2), hydrogen gas is evolved at the cathode.

Corrosion as usually encountered in practice with structures such as buried pipelines, stanchions, tanks, gasholders and the like can generally be classified under the following types:

Corrosion cells

Concentration cell effect. When an electrolyte in contact with an electrically continuous metal varies, such properties as the degree of aeration and particularly in the concentration of soluble salts, differing potentials will occur on the metal surface, so creating corrosion cells. Anodic or corroding areas usually exist in soils where soluble salt concentration is highest, and the electrical resistivity of the soil is lowest.

Galvanic cell effect. In a uniform electrolyte, differences in the metal surface due to its pre-treatment, involving such things as millscale or presence of inclusions, can cause corrosion cells. Likewise, the electrical continuity of different metals such as copper piping attached to steel in an electrolyte, will cause corrosion of the steel due to the galvanic cell effect.

Stray current effect. Direct electric current flowing through an electrolyte such as soil, may enter a metal structure to find a lower electrical resistance path in returning to its source. Where the current enters the metal, protection is afforded, but where it leaves the metal to re-enter the electrolyte, corrosion occurs.

Increased corrosion

Bacterial corrosion. In anaerobic or air-free soils, such as water-logged clays, sulphate-reducing bacteria can use cathodic hydrogen, so increasing the normal flow of current in the corrosion cell, with resultant increase of corrosion at the anodes. Sulphides are also produced, which can cause corrosion at the cathodes, but, under some conditions, protective sulphide films may form on the surface of the metal.

Since corrosion is produced by the loss of metal ions from the metal surface, corrosion cannot occur if we cause a positive current to flow to the surface from an external source. This is the principle of cathodic protection. Before adapting this system, however, a careful survey is necessary to obtain data so that the right method is selected, and proper design assumed.

Two systems of cathodic protection are in use:

1. *Sacrificial anode system.* Cathodic protection by sacrificial anodes can be effected by attaching to the structure, blocks of metal which are more electro-negative than the metal of the structure, and immersing them in the common electrolyte. Metals used are generally magnesium, zinc, and aluminium. The metal of the sacrificial anode readily loses positive ions to the electrolyte and consequently acquires a surplus of electrons, some of which flow by way of the metallic circuit to the protected structure. This depresses the structure's potential so that positive ions cannot leave the metal surface, *i.e.*, it is protected from corrosion.

2. *Power impressed system.* In some cases, the sacrificial anode system becomes impracticable on account of the high electrical resistivity of the soil or water electrolyte. Power-impressed currents may be used to effect cathodic protection by attaching the negative terminal of a d.c. source to the structure and connecting the positive terminal to a 'ground bed' immersed in the electrolyte. The d.c. source causes the transfer of electrons from the anodes to the protected structure which is thereby rendered cathodic.

Nature of material used

The reaction occurring at the anode ground-bed depends upon the nature of the material used. When it is iron or steel, the removal of electrons makes the passage of positive ions from the metal into the electrolyte easy, and the ground-bed corrodes. If it is fabricated from graphite, the reaction occurring most readily is the evolution of gas at the anode-electrolyte interface, and, consequently, graphite anodes have a long life.

The direct voltage generally used varies from about 6 V. in a low-resistance electrolyte such as sea water, to 50 V. in high-resistance soil. The voltage required depends on the current and the overall resistance of the external circuit. This resistance comprises principally cable resistance, resistance to earth of the structure, and resistance to remote earth of the anode ground-bed. Of these, the latter is normally the controlling resistance. Since the power cost is almost directly proportional to this resistance, considerable effort is often expended in reducing it to the lowest practicable value.

Structural design

The variations in the engineering design, and in the quality of protective coatings, apart from environmental differences, necessitate individual study of each structure before a satisfactory cathodic protection system can be designed to protect it.

For existing structures, current drainage surveys are conducted to assess the quality of the protective coatings, check electrical continuity of the structures, trace leakage of current to other structures, which it is not intended to protect, and to ascertain the voltage and current required to effect cathodic protection. The electrical resistivity and variations of the electrolytes, whether soils or waters, must in all cases be known.

Corrosion engineers

When designing cathodic installations for structures at the drawing board stage of development, the experience of the corrosion engineer is of major importance. With a knowledge of site conditions, the proposed coatings to be used, design of the structure itself and availability of power supplies, he can prepare the preliminary specification.

The choice between the use of sacrificial anode or power-impressed types of cathodic protection in cases where either is possible will depend on the type of structure, the locality in which it is situated, the electrolyte conditions, the availability of power supplies and general economics.

In the discussion which followed, members stressed the importance of obtaining reliable soil samples, and the opinion was expressed that interference by electricity straying from such sources as railways, tramway lines and G.P.O. installations could constitute one of the greatest enemies of a cathodic protection scheme.

'Se-Ridge' terminal for domestic gas appliances

THE venting of the products from gas appliances into a roof space or immediately beneath an open tile in the roof ridge has been practised for some time with reasonable success. The attractions of these methods are that the flue pipe is entirely concealed within the house and there is no visible termination other than the open ridge tile.

An installation of this kind is, however, trouble free only if significant condensation does not occur on the inside of the roof or the fittings within, and this can only be ensured by adequate ventilation of the roof space or by discharging all the products of combustion directly through the open ridge tile.

Wind

Since fulfilment of either of these requirements depends on the prevalence of favourable wind conditions they are not always fully met, and in adverse climatic conditions of low temperature and high humidity serious condensation within the roof may occur, particularly with continuously burning appliances.

In order to obviate this trouble, and at the same time retain the advantages of this form of venting, a design of flue terminal based on a ridge ventilating tile of the Red Bank Mfg. Company, has been developed by the South Eastern Gas Board laboratories, in conjunction with the technical staff of the Red Bank Mfg. Company. Registered Design has been applied for.

To the original tile made of kiln-fired terra-cotta, a plate has been added to the underside to form within the tile a venturi shape channel into which the flue products are led through an asbestos-cement adaptor bolted to the terra-cotta ridge components.

Birds

A polythene coated steel bar is fitted in each of the slots on either side of the latter to prevent the entry of birds and the composite unit forms a terminal which complies with the requirements of B.S. 766.

The results of laboratory tests with winds up to 20 m.p.h. incident on a 30° pitch roof in which the terminal was fitted show that extraction is effected by all winds except those downward within a small solid angle close to the line of the ridge.

Unlikely

Wind conditions, which would produce the adverse pressures of up to 0.07 i.w.g. measured in the tests are, except in special circumstances, unlikely to be of more than momentary duration in actual practice and would be offset by the thermal stack effect when an appliance is alight.

For example, this stack effect is calculated to be 0.06 i.w.g. for an instantaneous water heater rated at 95,000 B.t.u./hr. and 0.06 i.w.g. for a gas fire rated at 16,000 B.t.u./hr. each with a 20-ft. high flue.

It is considered, therefore, that no significant downdraught would be experienced unless location of the building were such that the ridge was subjected to a persistent strong 'near-vertical' downward wind.

Advantageous

The ridge level is in itself a position advantageous for location of the terminal as the pressure distribution around the building due to wind favours extraction through an opening at this position from lower levels where static pressures are usually higher than at the ridge.

It is, however, considered advisable not to fit the terminal closer than 18 in. to a vertical obstruction which could give rise to high static wind pressures. As with all flue installations the use of right angle bends should be avoided in a flue fitted with a 'Se-Ridge' terminal.

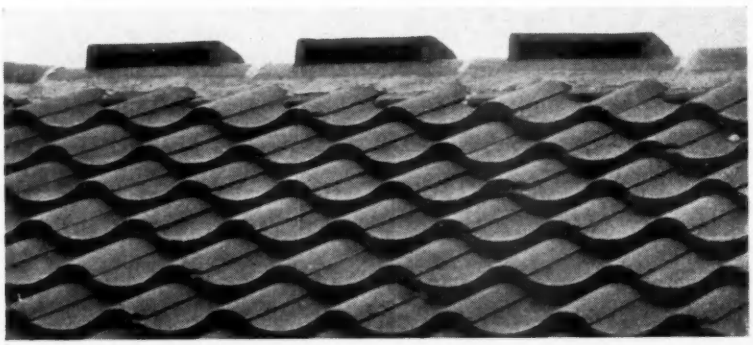
The terra-cotta ridge component, with various curved and angular base plates and finishes to match the range of ridge tiles in common use, is obtainable from the Red Bank Mfg. Company, Measham.

Adaptor

The asbestos-cement adaptor is internally coated with the acid resistant Duresco ARL 2230 finish and is obtainable from Urastone, Gravesend, with 3 in., 4 in. or 5 in. spigots suitable for connection by means of a split socket to B.S. size asbestos-cement pipes.

Fitting of the terminal in a roof ridge necessitates the formation of a gap 14½ in. long in the roof ridge board with trimmers on either side fixed to the rafters.

HOW IT IS LOCATED



This picture of a tiled roof shows how the 'Se-Ridge' terminals for domestic gas appliances are located in the roof ridge.

The derivatographic investigation of gas purifying materials

By Dr. M. WELTNER,

THE RESEARCH INSTITUTE FOR HEAVY CHEMICAL INDUSTRIES, VESZPRÉM, HUNGARY

ON account of its operational safety and the simplicity of the equipment used, gas purification by hydrated iron oxide is still extensively practiced in gasworks and coking plants for the absorption of hydrogen sulphide.

The capacity of this material to absorb and hold the hydrogen sulphide was formerly explained by the reaction between hydrogen sulphide and hydrated iron oxides giving iron sulphides. In the revivication process the iron sulphides are reconverted in the presence of air and moisture to hydrated iron oxide while sulphur is liberated.

It was shown later, however, by J. Györki[1] that the hydrogen sulphide activity of the material is independent of the iron content. In fact materials containing less iron may possess greater activity than those of higher iron content. The desulphurisation process was considered by Györki as a partial catalytic oxidation of the hydrogen sulphide on surfaces of great activity:

$$2\ H_2S + O_2 = 2\ S + 2\ H_2O,$$

during which, metalic sulphides may be formed in intermediate reactions.

The same view is also held by M. Mintschew-Raltschewa,[2] who found that changes in its crystal structure and physical properties, depending on the circumstances of its formation, play an important role in the activity of the material. These properties are to a certain extent independent of its hydrated iron oxide content.

Alpha and gamma modifications

For good performance the gas purifying material should contain active alfa or gamma modifications of iron hydroxide in adequate quantities. The alfa modification is to be found in natural bog ores, while the gamma modification is present in red mud, the waste product from aluminium manufacture.

Chemical analysis alone is not enough to determine whether hitherto untried purifying material will give a satisfactory performance in any particular plant. The active elements in gas purifying materials consist largely of colloid substances, and the properties and the surface activity of these gels depend to a great extent on the circumstances of their formation, on the substances absorbed by these activated surfaces and on other factors.

The amorphous gel formed by the reaction of ferric and hydroxyl ions is a spongey, rigid substance, consisting of a mass of capillaries, filled with water. The continuous shape of the water-content/temperature curve shows that no hydrates of distinct composition are present. Ferric hydroxide, precipitated from a ferric salt solution begins to glow suddenly at higher temperatures. This phenomenon had already been described by Berzelius in 1820, and it was later found that precipitated either hot or cold it exhibited this property of glowing. Data in the literature differ as to the temperature at which the oxide glows, but K. Endell and R. Riecke observed it at 450°C though A. A. Baikow recorded it at 380°C. The glowing is accompanied by a sudden rise in temperature, attributed by L. Wöhler to the decrease in the surface of the finely dispersed gel, by J. Böhm to the effect of crystallisation, and by L. Blanc to the conversion of the unstable crystalline form of Fe_2O_3 into the stable form.

The ageing process

Since some gas purifying materials are by-products of aluminium manufacture, they may also contain aluminium hydroxide gels as well as ferric hydroxide.

The amorphous gel, formed by aluminium and hydroxyl ions, also consists of an aggregate of molecules containing water, and this structure only changes gradually into a lattice form, during a process known as ageing.

When newly formed the molecules always consist of $Al(OH)_3$, but water is split off intramolecularly from various molecules to form polyhydroxides. The product of further conversion is the meta-hydroxide, AlO(OH).

Dupuis-Duval[3] has studied the thermobalance curves of $Al(OH)_3$ prepared in 21 different ways; each gave a different curve. The aluminium hyroxide gels as prepared are not definite products, and their properties differ substantially according to their history before formation, the temperature of precipitation, their *p*H value, the quality of the solvent and the concentration of the constituents in it. In time the properties of each will alter, and each will age.

X-ray studies

From these hydroxides of differing properties the corresponding oxides are formed over a wide temperature range. In X-ray and thermo-analytical studies on the decomposition of hydrated aluminium oxide by heat, Sasvári and Hegedüs[4] have shown that not only aluminium hydroxides of identical formula, though of varying structure, may substantially differ thermoanalytically,

but also those of identical formula and structure which have been precipitated from different media, and so contain different impurities.

Since the appropriate crystalline modifications also have several forms, it is only natural that a study of the structure of gas purifying materials and the mechanism of hydrogen sulphide removal should be a problem of great complexity.

Derivatographic analysis, developed in Hungary[5], opens

TABLE 1.

No.	Fe_2O_3	Al_2O_3	CaO	MgO	SiO_2	SO_3	P_2O_5	pH
1.	59·20	3·85	5·76	1·50	11·05	6·20	0·10	9·1
2.	50·40	6·10	0·64	4·83	21·00	0·56	0·20	8·2
3.	47·40	16·40	1·72	2·04	7·18	1·20	—	9·4
4.	39·50	5·05	3·88	1·30	7·20	0·96	1·68	6·0
5.	37·40	20·15	6·90	1·49	10·53	0·77	1·15	7·1
6.	9·57	26·00	9·88	0·84	18·30	3·05	0·47	10·1

up new possibilities for the studying of the structure of these materials.

This method makes it possible by a single, automatically recorded measuring process to obtain the change in weight of the sample and the T.G. curve, during heating. In addition the differential thermal analysis curve, the D.T.A., can be drawn which gives information on the heat effects and the endothermic and exothermic processes taking place during thermal decomposition. Its chief advantage is that it makes it possible to carry out a continuous measurement by instrument of the rate of loss of weight. In this way the decomposition temperature, characteristic of the sample, can be easily determined.

The crucible, holding the sample, is balanced on the left arm of the derivative thermobalance. The crucible is surrounded by a laboratory crucible oven, by which the sample may be heated at any desired rate. On the right arm of the balance a strong, permanent magnet is suspended inside an induction coil. When a loss in weight of the sample occurs during heating, the magnet moves downwards, inducing a magnetic flux inside the coil, which is registered by a reflecting galvanometer. From this, values for the D.T.G. curve may be calculated.

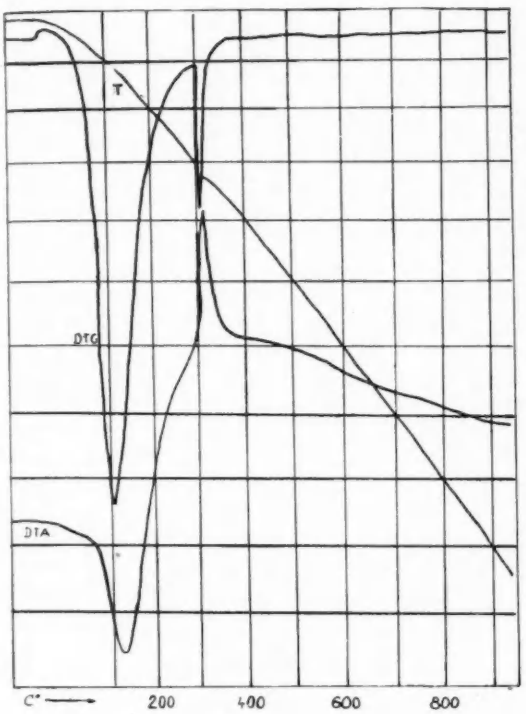
The intensity of the induced current is proportional to the rate of the displacement, and so furnishes direct data on the rate of decomposition of the sample.

The following derivatographic investigations, which are now described, were carried out on six samples of gas purifying materials obtained from the gasworks in Budapest.

The chemical composition and the *p*H values of the samples investigated are shown in Table 1, in the order of the Fe_2O_3 content. The table also shows that the composition of the samples varied within fairly wide limits. Table 2 shows the analysis of the purifying materials as

TABLE 2

No.	Original water content, %	Water content at saturation, %	Soaking point, %	H_2S-uptake		Sulphur content of the dry, spent material
				on wet substance	on 100g of dry material	
1.	—	5·0	45	1. 36·0	37·8	26·2
				2. 26·6	28·0	38·2
				3. 20·4	21·4	45·0
				4. 14·0	14·7	48·8
			Total :	97·0	101·9	
2.	17·62	17·62	21·7	1. 17·40	21·12	16·6
				2. 15·30	18·56	27·2
				3. 7·22	8·76	31·3
				4. 2·20	2·67	32·5
			Total :	42·12	51·11	
3.	41·80	42·10	47·6	1. 14·66	25·31	19·23
				2. 14·18	24·49	31·90
				3. 11·16	19·27	39·39
				4. 10·42	17·99	45·03
			Total :	50·42	87·06	
4.	51·80	51·80	54·9	1. 14·0	29·0	21·4
				2. 9·0	18·6	30·9
				3. 8·0	16·5	37·6
				4. 7·0	14·5	42·4
			Total :	38·0	78·6	
5.	32·84	30·6	35·24	1. 16·6	23·9	18·4
				2. 12·3	17·8	28·2
				3. 7·6	11·0	33·15
				4. 12·9	18·6	40·17
			Total :	49·4	71·3	
6.	25·2	24·9	57·2	1. 7·2	9·6	8·3
				2. 0·8	1·1	9·2
				3. 0·5	0·7	9·7
				4. 0·5	0·7	10·2
			Total :	9·0	12·1	



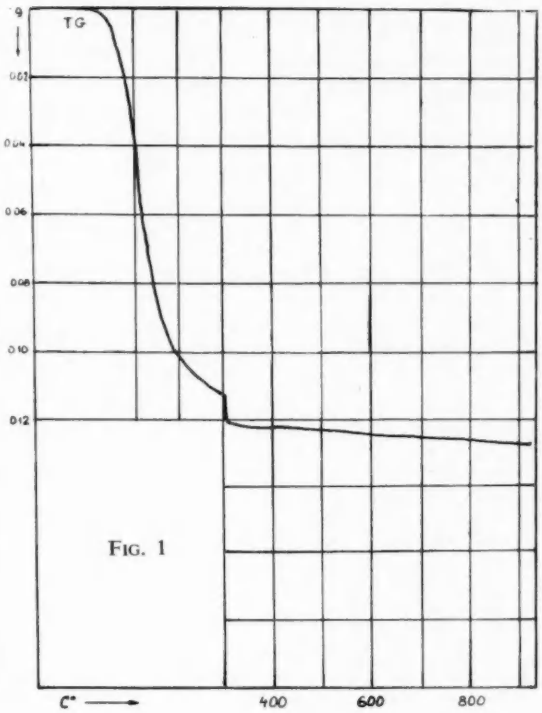
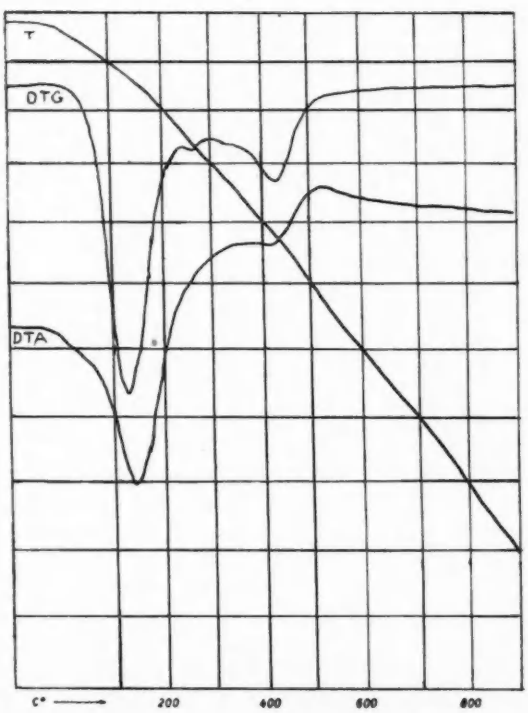


FIG. 1

investigated, obtained in the gasworks laboratory at Budapest. When comparing the data on the capacity to absorb hydrogen sulphide the proportion of Fe_2O_3 in the material does not always correspond to its activity for absorbing hydrogen sulphide. The capacity of Zeleznik to react with hydrogen sulphide is, for example, substantially less, than would be expected on the basis of its Fe_2O_3 content.

In the derivatographic investigation of gas purifying materials, the samples were heated at a rate of 10°C. per minute. In each case not less than two parallel experiments were carried out. The decomposition temperatures obtained



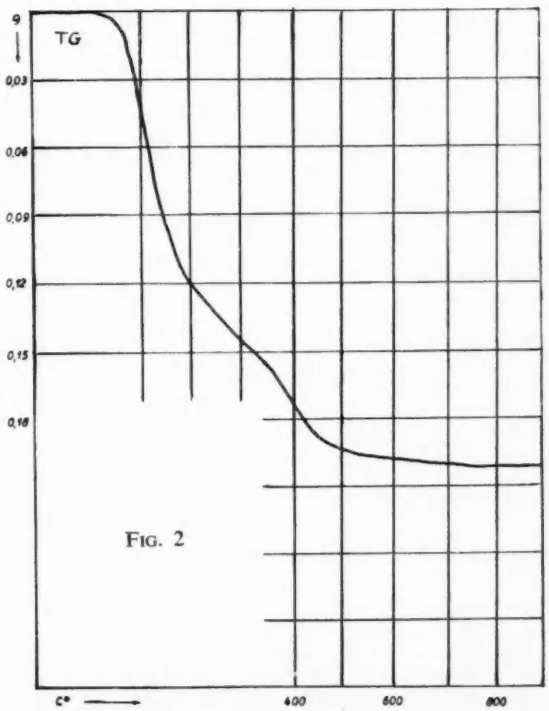
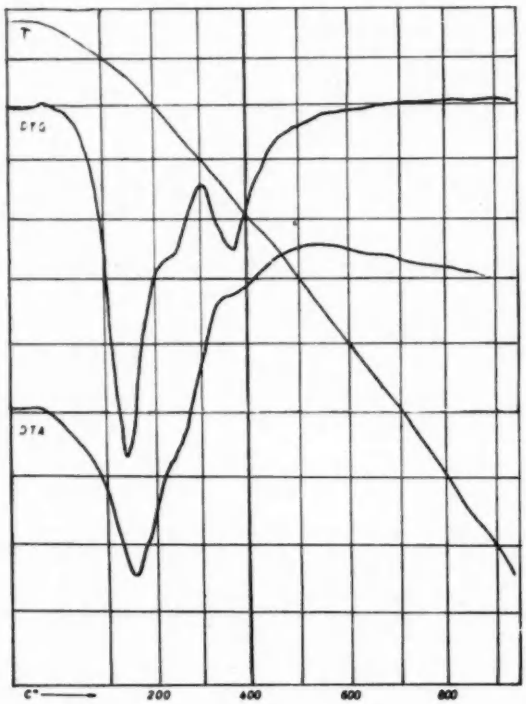


FIG. 2

in each set of experiments, did not differ by more than ±10 to 15°C. In giving the percentage height of the peak of the D.T.G. curves, the average decomposition rate from room temperature to 800°C was taken as 100%. This value was determined by measuring the area below the curve by planimeter. In most cases the computed percentage height of the peak of the D.T.G. curves did not differ by more than 1 to 2% in parallel experiments. Since any greater differences were exceptional, the reproducibility of experimental data may be considered excellent.



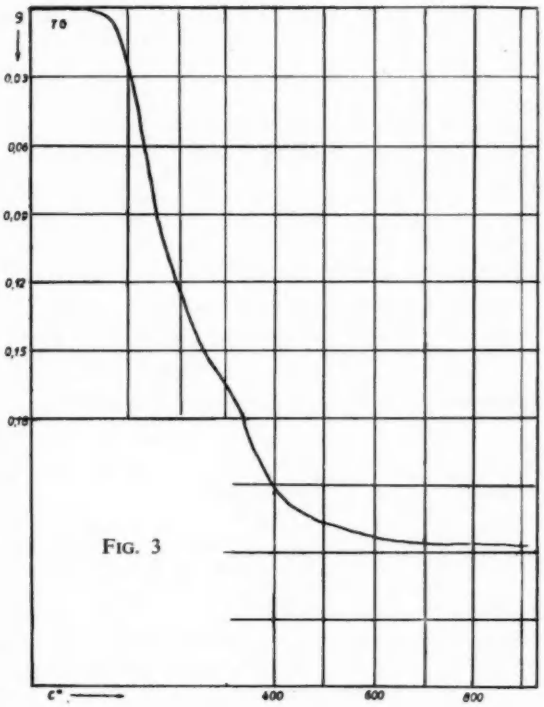


FIG. 3

To interpret the behaviour of gas purifying substances, derivatographic investigations were carried out with air-dried samples of Fe $(OH)_3$ (sample No. 7, Fig. 1) and $Al(OH)_3$ (sample No. 8, Fig. 2), precipitated with ammonia solution from ferric and aluminium salts, respectively. Of further samples of substances containing iron and aluminium salts in a molar proportion of 1 : 1, one was precipitated at 70°C with ammonia in great excess (sample No. 9, Fig. 3), and the other at room temperature, with a slight excess of ammonia (sample No. 10, Fig. 4).

The results of the derivatographic investigations are summarised in Table 3.

Marked difference

Derivatographic investigations show a marked difference between the various materials. One group of the samples gave substantially only one decomposition peak on heating, while in the other group two decomposition peaks were observable. One of these occurred at temperatures of 80 to 120°C, while the other peak was to be observed at temperatures, of 250 to 275°C. The decrease in weight of the purifying material at such low temperatures may be ascribed to the splitting off of OH groups to form water, which suggests that the OH groups contained in gas purifying materials are bound by two kinds of bonds, which split off at different temperatures.

In the derivatographic investigation of the $Fe(OH)_3$ and $Al(OH)_3$ precipitates, only the decomposition peak occurring at 110 to 120°C. was observed. There was no peak at 250 to 275°C., though there was an indication of a peak at 265°C. in the case of $Al(OH)_3$. When investigating crystalline $Al(OH)_3$, Erdey, Paulik and Paulik[6] found a D.T.G.-peak at 260°C., so it can reasonably be supposed, that this indication of a peak marks the beginning of crystallisation.

Since the crystal forms of Al··· and Fe··· salts show conformity in many respects, both the crystalline Al_2O_3, corundum, and the crystalline Fe_2O_3, hematite, form ditrigonal scalenehedral crystals, and both AlO(OH), diaspore, and FeO(OH), gothite, form dipyramidal rhombic crystals, it is reasonable to suppose that the ions of the two metals behave similarly when precipitated in amorphous form.

The comparison of the results of derivatographic investigations of the chemical analysis and of the tests for the capacity to retain hydrogen sulphide, suggests that the OH groups splitting off at lower temperatures are more active in their ability to retain hydrogen sulphide than those splitting off at higher temperatures.

Special attention should be paid to the behaviour of $Fe(OH)_3$ as revealed by derivatographic analysis; it is also of exceptional interest from the theoretical point of view.

The striking decomposition peak of the D.T.G. curve at 110°C indicates the splitting off of OH groups in the form of water. The steep, exotherm peak of the D.T.A. curve at 325°C is a good indication of the sudden glowing, already observed by earlier investigators.

Figures to which reference is made but which do not appear above, will be included in the continuation of this article.

From a paper to the Scottish Association of Gas Managers, Largs, September 15.

Press and public relations

By ROBERT DUNNETT, M.A.,
PRESS AND PUBLIC RELATIONS OFFICER,
THE SCOTTISH GAS BOARD.

THE function of public relations has been defined by the Institute of Public Relations as: 'The deliberate, planned and sustained effort to establish and maintain mutual understanding between an organisation and its public'.

One of Britain's most widely experienced public relations advisers, Mr. J. H. Brebner, has written: 'The conduct of the day to day business of a firm is delegated to a number of sectional executives, to each of whom it is given to exercise a limited and strictly defined part of the power vested in the head of the organisation. The public relations function can never be specifically linked with one of these. The public relations expert in his own field is responsible for everything'.

These are definitions by experts in public relations. In practice the management of most large organisations do not accept the full implications of these definitions, even when they feel that they need the help of specialist full-time public relations staff. There are very human, if not very logical, reasons for this. How do you control a man who has got to know as much as possible about the workings of every branch of an undertaking (in order to project a balanced view of the whole) and yet, since he is not professionally qualified in terms of these executive functions, cannot take responsibility for any of them? Such a range of knowledge is appropriate—and necessary—for chairmen, managing directors and board members. It is the raw material out of which they shape the policy and overall direction of their undertaking. In the United States where public relations, like the Press, is accorded a generally higher status than in this country, public relations specialists are frequently brought in at the level of policy making.

Policy Boost

In Britain, common practice is that the public relations function is used to put across to the public whatever policy has been decided. Since the whole profession is very new (it only really got under way in the 1930's) and since it contains a startling assortment of characters, with widely varying codes of practice, there is a good deal to be said for British caution. Working definitions are necessary, but in this business so much depends on the particular character of an organisation and the personalities involved in shaping its public relations, that hard and fast rules are best avoided. Industrial public relations is only one small part of that big area in modern life where there is a meeting of minds between people whose background is essentially scientific and technical, and others trained in the humanities. Each can help to widen and deepen the other's point of view, and so contribute to a general growth of understanding which, when all is said and done, is going to be good for us all.

The principal duties of the public relations staff in any large organisation may be quite precisely defined, but since they involve a very wide range of activities, the real problem in securing effective results is one of selection and of emphasis. The question as to which of the many possible duties public relations people should perform, and the amount of energy they should devote to each, can only be satisfactorily answered by assessing the needs of the organisation to be served and its capacity to provide the raw material which, when professionally handled, will promote its best interests. Such an assessment is bound to be a compromise.

Compromise

It involves on the one hand the opinions of the professional management of the organisation, with their detailed technical knowledge of their business, but no particular knowledge of practical public relations work; and on the other hand, the technical knowledge of the public relations expert in his own wide field of all forms of communication. It is essential that management and its public relations staff should recognise that their relationship derives its vitality and value from the fact that useful action depends upon this compromise being mutually accepted. The executive direction of any organisation is a whole time job, demanding 100% application of special skills; and the best results come from men making the fullest use of the talents they possess. The collection of information, the shaping of it into forms appropriate to different media, and the planned use of these media, is also a job for which special talents are required, and to which they must be exclusively devoted.

It is true, of course, that some kinds of subject matter have a greater appeal than others, but this generally depends upon the personal inclination of individuals. The real point is that the public relations man can no more afford to become emotionally involved in the profession of his employer or client, than that employer or client can afford to become committed more to the profession of communication than to the exercise of those technical skills by which he earns his living. Ideally, the rôle of public relations in any organisation is that of a sympathetic, detached professional observer. It is not always easy to maintain this position in the gas industry which today, as in the past, commands the service of so many dedicated men whose enthusiasm is infectious. This, in itself, of course makes it all the more important that the industry should have the service of men from other professions who are equally committed to their particular rôle in life. This proposition would not seem at all remarkable if applied, for example, to the profession of medicine or the law. But the profession of being concerned with communications is so new, so very much a product of the mid-twentieth century, that it has not yet even acquired a generic name, and scarcely seems comparable with the traditional vocations.

With the swift development of so many new or enlarged

means of communication, journalism is only one of the branches of public relations work. It is even debatable whether it is the most important part of the work. The emphasis put upon it in the title of Press and Public Relations Officer so often chosen by organisations, sometimes reflects more the managements' concern about what they conceive to be the raw deal they are getting from the Press, rather than a considered view of what can be done about it. However, all forms of Press work are undoubtedly of major importance, and in themselves offer a great variety of opportunities. National and local newspapers each have their own special requirements, both individually and as distinct in kind; literally scores of different interests in the community have one or more periodicals specifically directed to them, from big popular women's magazines to highly specialist journals with a small but profoundly critical readership.

In any large organisation two or three trained journalists could be wholly occupied in supplying news, features, photographs and special technical articles to the Press; in organising Press visits and conferences; and maintaining personal contact with members of the editorial staffs. Such work must, however, be only a proportion of the total effort which includes making the fullest possible use of sound radio and television (the short talk, the interview, the dramatised feature, the discussion); of films, whether newsreels or documentaries; of initiating publications ranging from an internal house magazine to leaflets, illustrated brochures and popular versions of annual reports; and also of considering the use that can be made in appealing to the public on particular occasions through exhibitions and demonstrations; and through contact with a great diversity of social groups, like Rotary Clubs, Chambers of Commerce, and all kinds of voluntary organisations up and down the country. It is surprising, when today electronics have exposed us all to such a violent barrage of speech, that oratory is still so widely appreciated and, although after-luncheon and after-dinner speeches can be—and too frequently are—overdone, they remain a valuable and important means of primary communication.

A losing battle

If firms could invent, manufacture, and profitably sell things without anybody making comments on how they, or anybody else, conducted their business, they would scarcely cut their profits, even fractionally, to establish a non-productive department, and indeed, as the number of people engaged in public relations, especially in Britain and the United States, increases every year by thousands, quite a number of firms still feel that the whole thing is, to put it as politely as possible, detached from commercial reality. Those who are strong-minded enough to do without any specialist help in this field appear, however, to be fighting a losing battle. Public relations proliferates as never before on both sides of the Atlantic. It suffers sometimes from having grown too fast and because too much is expected of it. There is no mystery about it, although it sometimes pays those who use it and, even some practitioners, to act as if there were. It exists because modern mass communications have released an omniverous curiosity in the public mind, which grows with what it feeds on, and which cannot be ignored. The professional standards of good public relations work must correspond to the highest professional standards in the media of communication. These are then applied to the sympathetic interpretation of the policy and specialist functions of the organisation concerned.

Articles issued to the Press must be good journalism, not just technically right from an organisation's specialist point of view; radio programmes must be good listening or viewing, not just what the people in the organisation want to hear and see of themselves; books and pamphlets must be typographically perfect, and so on. That is the ideal, and any organisation that achieved it all the time would have a reputation glowing like nothing yet seen on land or sea. What makes the ideal so difficult to attain (and so rewarding when it *is* attained) is precisely the inevitability of compromising between what the specialist in the chosen medium wants to do and the impression which, for internal professional reasons, an organisation feels it ought to make—and neither or them of course, wholly right or wholly wrong.

Latent energy

Much of public relations work must therefore be directed towards reducing the size of the area in which compromise has to be made. This involves a constant and careful assessment of the ability of the organisation to project itself into the public mind; and the planned use of that ability in the most suitable and constructive ways. An organisation like the Scottish Gas Board, which employs thousands of people over a huge area, has immense stores of latent public relations energy; it also has almost certainly a more limited number of people who, while being aware of this energy in themselves but not of its effect on others, are prepared to let fly with it whenever the mood takes them. To encourage the former to express themselves and the latter to control themselves (without loss of enthusiasm) is one of the ways in which public relations can foster an ever-increasing appreciation of its aims. It is obviously highly desirable that a big public concern should speak with one voice, wherever its utterances may be made, or by whatever means they are made. The effectiveness of what it has to say is immensely increased if it is said by many different people in many different contexts. An ' official spokesman ' is necessary on certain occasions, but more often the best effects are achieved by people addressing themselves to their fellow citizens (or even across the garden wall to their neighbours).

The function of a public relations officer who, in large organisations, must necessarily work at a remote headquarters, should never be to superimpose himself on local efforts. His function is rather to assess the energy and potential of such activity in all areas, to leave it to express itself where it is doing so satisfactorily, to free and enlarge it where it is unsatisfactory, and to co-ordinate all the various isolated efforts into an expression of a wider purpose, where they lend themselves naturally to such treatment.

Communication

This kind of thing cannot be done by directives from headquarters. It depends upon keeping open and constantly developing, internal lines of communication, whereby an ever-increasing exchange of news and views about the organisation, progressively create in individuals at every level a common feeling of its character, and a sense of personal identity with it.

This sort of thing is not done in a night. A regular house magazine, particularly if it is supported by a network of local correspondents and reflects a wide range of activities in warmly human terms, can build up the kind of general interest that is required. The process of compiling the magazine keeps internal lines of communication open, and should, as it were, extend the network. Even if the magazine itself only appears eight or nine times a year, this process of encouraging people at all levels to talk about their jobs and themselves is continuous, and its ultimate

effect ought to be to make an increasing number of people continuously aware of the human nature of the organisation in which they work. By itself a house magazine will not achieve this end. The inner lines of communication have to be kept open all the time, and it is a function of management to ensure that they are. The raw material for much constructive public relations work is to be found not only in individual activities, but in communal local efforts, wherever employees meet either to discuss internal problems or their specialist interests, as in sales circles and the like. In every big modern industry the departments concerned with industrial relations, with education and training, with health and welfare, have their own techniques for dealing with their particular tasks. The public relations department is not trained to operate in these specialist fields, but it must be acutely interested in all that happens in them, because the sum total of these activities is the achievement of good human relations, without which no organisation can have any lasting success either in its own internal affairs, or in its relations with the public.

Having outlined some of the main aspects of this new and still rather unsettled profession of public relations in general terms, I now turn, in the role of sympathetic, detached, professional observer, to the application of these general considerations to the gas industry in Scotland. This must be an individual point of view, and one which may, I hope, stimulate discussion.

Four considerations

The foundations of a constructive public relations policy for the gas industry in Scotland seem to me to rest on four considerations, which must be kept in mind all the time by everybody; and from which we must not allow ourselves to be distracted by internal or external problems. The fact is, as I understand the industry, that the pressure of these difficult times, may give rise to feelings of despondency, and while I can sympathise with many of the reasons for this, I think they would make William Murdoch, Sir Walter Scott and Lord Kelvin turn in their graves. These were among the great Scots who firmly believed in the gas industry, and were confident that future generations would see to it that, however much it changed, it would become under the pressure of all kinds of competition which they and others of lesser fame but equal confidence, helped to establish this idea in the public mind: and they did it to such purpose, and on such sure ground, that even to-day, under the pressure of all kinds of competition which they could scarcely imagine, this basic confidence in the industry remains one of the surest foundations on which it will build towards the future. The new developments in the techniques of production and distribution, in the manufacture of appliances, in the applications of gas to industry, all provide new means of firing the public imagination and renewing its confidence. Indeed, the four points on which I believe our public relations must rest are all related to this conception. We can use the various public relations media at our disposal to best advantage only if we are quite clear in our minds about our intentions. In other words, we must be quite sure ourselves that we are not trying to make a poor case look good, or to cloak a feeling of inferiority, or to justify some half-hearted hope.

I could not pretend to be a detached observer if I did not add that I am well aware that feelings of this sort do find expression at times in the industry to-day; and do it quite unnecessary harm. They do not correspond, on any objective assessment, to the reality of the industry's present achievements and developing prospects; they are perhaps a reflection of what has been said about gas in some quarters, which were prejudiced, and in others, which were ignorant. But they altogether ignore the goodwill towards the industry built up over 150 years, and still present in hundreds of thousands of homes all over Scotland. It is in my view, against this background of swiftly developing prospects and established public satisfaction, which are true and consistent with the real nature of the industry, that a boldly progressive public relations policy may be vigorously pursued in all available media.

The four main heads under which this operation may be most successfully carried out involve, I suggest, an attitude of mind inside the industry which will lead us also in all our external activities to:

(1) Confirm public confidence.
(2) Challenge centres of influence.
(3) Inspire youth.
(4) Live for the future.

(1) *We must confirm public confidence*:

I use the word 'confirm' rather than 'create' or 'restore' because I am concerned not only with the public attitude to the industry, but with a way of thinking which sometimes occurs inside the industry, and is, I believe, based on a misconception.

This may in extreme cases crystallise itself into a gigantic chip on the shoulder, which acquires a menacing glitter whenever the subject of the Press reporting of gassing incidents is raised. When this happens, it does nothing to improve our relations with either the Press or the public, and it may well, at least temporarily, lower morale. So it is essential that we get this matter into perspective. The fact is that gassing incidents are news, and the Press would be failing in its duty to the public if it did not report them. The actual number of reports published which include errors of fact, are minute. It is not necessarily misreporting if a newspaper excludes from a story facts which *we* think should have been included; and there are never any grounds for supposing that a newspaper is actuated by malice when it places an emphasis on incidents which we regard as harmful to us. It is quite unrealistic to suppose that, so long as the toxic content of gas remains as it is, there will not be a newspaper coverage of gassing incidents corresponding to the present level.

Not a panacea

Public relations is not a panacea for all ills. It can help to develop a generally sympathetic attitude towards the industry's problems by maintaining close professional contact with members of the Press; it can take up, in the same way, cases where obvious mistakes have been made; it can help to get publicity for the steady progress that is being made towards reducing the toxic content of gas, and for the valuable work that is done for aged and infirm customers: and space will be readily accorded by any newspaper to such information.

While it is perfectly understandable that people in the industry, rightly proud of its record and anxious for its prestige, should react very strongly to the publication of news of gassing incidents, it is very necessary to realise that this does not represent a hostile attitude on the part of the newspapers: and that we do ourselves quite unnecessary harm if, because of the chip on our shoulders, we adopt a hostile attitude towards them.

Therefore, it is essential that in all our dealings with the public, at every level, we should reflect confidence, for which there are sound grounds, not only in the work that is being done inside the industry, but in so many forms of objective appreciation of it.

The way in which the public relations function can help to do this, is by seeking to draw from all available sources in the industry information about new developments in manufacture, distribution, utilisation, and cus-

tomer service, and to present it as professionally as possible in terms of the media at its disposal.

(2) *We must challenge centres of influence:*

While it is a regular part of the public relations function to supply articles to the popular Press, to stimulate features by special writers, to seek out news and personality stories, and opportunities for broadcasts or other public appearances which will promote interest in the industry, and keep it in the public mind; it is also more than ever necessary to ensure that certain specific and influential groups of people are constantly kept aware of what the industry is doing; and are provided with information in a form specially adapted to their needs.

These groups range from the whole body of Scottish Members of Parliament to the smallest local authority. They include professional organisations, Chambers of Commerce, and a great variety of voluntary bodies. Through them it is possible to penetrate very deeply into the national life. Many such contacts are, of course, made already on behalf of the industry by different departments and at all levels.

A challenge

What I am suggesting here is that as a basic element of public relations policy, and as a result of the whole industry speaking (we hope) with one voice, these contacts should all be made in terms of a challenge. A polite, a firm, an informed challenge—but nonetheless a challenge.

In spite of the existence of a general public goodwill, and an increasingly favourable Press, it is quite clear that there are areas of appalling ignorance about the importance of the gas industry to the national economy in those very bodies who are most strategically placed to make large decisions on the long term use of fuel and power. I refer, of course, to Scotland only, though it may well be true elsewhere. So far as direct public relations action is concerned, these areas of ignorance can be attacked by the publication of special articles in the responsible daily press, or in the specialist journals designed for particular groups (and many of these journals are very co-operative). But much more needs to be done: and if time and staff permitted, I would like to see a regular serious publication specially prepared and issued, perhaps quarterly, which was designed to keep all centres of influence informed about the latest major developments in the industry, and which hammered home the essential role gas must fulfill in the whole context of Scotland's need for fuel and power now and in the future.

(3) *We must inspire youth:*

There is no doubt that one of the reasons why many otherwise well-informed people in positions of influence remain woefully ignorant about the gas industry, is that over many years they have been subjected to a constant outpouring of highly skilful propaganda for electricity and nuclear power. It is only within the last few years that we have seen the enthusiasms of the pioneers of nuclear energy cut down to something approaching commercial reality; and it is also only within that same brief period that the gas industry has risen to meet the challenge of the second half of the twentieth century. Today it is in a better position than it has ever been to capture the imagination of the young mind. Excellent examples of what can be done (in this as in so many other directions) are provided by the pictorial features arranged for children's magazines by the Gas Council. What can we do in Scotland? We have made something of a start with two dramatised sound radio programmes of twenty minutes each, which will together have got something of the story of the modern gas industry across to at least 60,000 children in the class-room. Much more needs to be one, and perhaps can best be done on a continuous basis through local contacts with education authorities. It should certainly be the aim of every district manager to see that the schools in his area have the latest coloured wall charts; are offered the use of films; and that whe ever possible the opportunity is taken of interesting the chi ldren in any competitions run by the industry for them. With all that is happening in the industry today, we shall have no excuse (and there *was* an excuse before) for le ting another generation grow up in dangerous ignorance o the place of gas in the national fuel economy.

(4) *We must live for the future:*

This final point is really intended as a summary of the three preceding points. My submission is that if we persistently think and act on the basis of confirming public confidence, challenging centres of influence, and inspiring youth, we shall develop the momentum which will project us into an expanding future. To assist in this process the public relations functions within the industry, while being principally concerned with interpreting the work of each department as it affects specific interests in Scotland, must also reflect the world-wide significance of the new gas industry. There is a strictly practical purpose in this. We want people to think of gas as modern in every way. We feel, rightly, that there is still a tendency to think of it as old-fashioned. The best way to counteract this, of course, is to make people familiar with all the practical advantages of the latest appliances, and especially to-day of the ultra-modern standards of comfort in the home which gas-fired central heating provides.

Every individual customer who is satisfied, and goes around saying so, is an invaluable asset to public relations. But today, as the new gas industry develops in so many different ways, we have the means of creating a feeling of national pride in the industry as a whole. We can, for example, show how techniques which have been practised in Europe, Africa, Australia and America, have been developed and adapted for the Westfield works and for the supergrid. We can point to forward-looking experiments like the Methane Pioneer. We can show, in many ways, how swiftly the industry is growing, how essential it is in the life of the most modern nations in the world, and how we in Scotland are shaping an industry to our own design, which will be as modern as any anywhere. This, too, must be part of our public relations policy.

Operates in two ways

The public relations function operates in two ways. It exists to interpret the work of an organisation to the public in terms of the professional standards of all available means of communication. It also seeks to keep the organisation informed of the public reaction to its work, as this is revealed in those means of communication. Its aim is always to secure mutual understanding.

In the Scottish gas industry today, the many new developments which are taking place offer a great variety of opportunities of promoting a new and lively interest in the mind of the general public, and in many centres of influence. There is already some evidence to show that the present position of the industry and its vigorous efforts to seize new opportunities of service to the nation, are being more generally and sympathetically understood.

In these circumstances a deliberate, planned and sustained exercise of the public relations function aimed at confirming public confidence, challenging centres of influence, and inspiring youth, can materially assist the industry to gain the place in the national life which its inherent values deserve.

DISCUSSION

Mr. A. McFadyen, Controller of Sales, Glasgow and Western Division, opening the discussion, said that Mr. Dunnett had put forward the ideal rôle of public relations in any organisation—that of sympathetic, detached professional observer. 'I believe that at times he must be attached, even prejudiced, and, if necessary, unprofessional,' commented Mr. McFadyen. 'I would be most unsympathetic at all times to our competitors.'

Mr. McFadyen added that the Scottish Gas Board had a number of employees meeting the public often. This called for good public relations. Mr. Dunnett had observed that the 10,000 employees of the Board formed an immense store of latent public relations energy. 'But they are not latent. Unwittingly, perhaps, many of these employees are giving an impression to the public. Are they making the public think well of us? Some are and some are not. I believe our internal communications are good down to a certain level of junior management, but they do not go far enough down to embrace the people who meet the public every day that they work. I often wonder what impression they give the public. I think that the new Area Managers' Committee has shown already that it can feed information to Mr. Dunnett and help him in his duties.'

Important call

Mr. Dunnett's call to inspire youth was a very important one, but that youth must be inside the industry as well as outside it. Young employees of the Board must be inspired to feel that they were working in an industry that had a great future ahead of it, with limitless opportunities.

Mr. A. M. Jackson, Dumbarton, pointed out that the spirit of any organisation was created by performance. A good place to work, congenial associates, and excellent human relations were splendid adjuncts, but they were of no avail if accomplishment was not present. Accomplishment rested on planning and decisions. What they did would always be more important than what they said or wrote; sound policy and decisions preceded efficient communications. However, effective communication was a key to effective leadership, and they must recognise that public relations was here to stay. It must not be regarded as a separate function but as an integral part of management. 'We must understand that public relations is not a defensive measure to cover up mistakes of management, not merely a Press agency, handshaking or entertainment.' More and more information was demanded by employees and the public generally about all the things which affected them. 'The employees are keenly interested in the Gas Board's affairs, and this must be met by a skilled treatment of the news, in a way which makes for understanding between employer and employee. The communicating of information is one of the best ways of improving morale.'

Mr. Dunnett had spoken of 'difficult times and feelings of despondency.' Should he not have made a mention of the cause, 'due to the uncertain future of the individual and his job, and the feeling of remoteness due in part to a complete lack of communication? We know that one of the most important desires of any employee is to feel secure in his job. The new management requirements for production, distribution and sales have not always fired the imagination of the staff and employees.'

Reference had been made to the difference in outlook between engineers and salesmen, but they were aware that in the past the engineer and manager was essentially a salesman. There were few people who could not give a good account of themselves in a wide variety of tasks, and this should not be forgotten. It was still essential that they should have a 'Mr. Gas' in every village, town and city.

Mr. Jackson concluded: 'We know we must produce gas more cheaply, and sell more, and this is where it is essential effectively to present the advantages to the consumers. Public relations is a new top level position and must be placed alongside sales, manufacturing, engineering and administration. I trust that there is ample opportunity in this growing field of public relations, with appropriate rewards for those who will work hard.'

Best industry

Mr. A. Bogie, Press and Publicity Officer, Glasgow and Western Division, agreed that new entrants should be indoctrinated with the point of view that the gas industry was the best industry to be in, so that, as the years went by, they would have thousands of employees confirmed in that belief. 'I do think that Mr. Dunnett has been extremely kind to the Press. He says they are not very often inaccurate. I admit that these inaccuracies may be due to the rush of the job and getting the stuff into print, and that there is no malice. What I object to is how they embroider the stories. These stories affect us very badly. As a practical exercise I made a list of about 20 of the most juicy of these things and took them to the newspaper concerned. The two directors I saw listened with growing blushes and took the point.'

Replying to the discussion, **Mr. Dunnett** referred to 'a horrid phrase, invented, I think, in Australia, called "human engineering."' That, he said, was the last thing he believed in. They must not indoctrinate at any point. Mr. McFadyen's suggestion that the public relations official should be prejudiced in the organisation he served was probably true and the officer was bound to be so, 'but I think sometimes he has to resist it.'

He agreed with Mr. Jackson that effective communication was the key to effective leadership. 'The more we can concentrate on getting communications internally, the more we shall know what direction the whole industry is taking.' The observation that the function of public relations was never to cover up for management was very sound. 'I still think that although Mr. Bogie achieved blushes on the part of two newspaper directors—and that is quite a good thing to do—on the way they treat gassing incidents, the fact remains that this would apply to motorcars, electricity, etc. The sensational Press is with us, whether we like it or not. Although these directors did blush, they would blush a great deal more if their profits went down.'

Personal contacts

It was essential, he added, that personal contacts should be developed, and the results made known among each other on the various occasions when there was a common meeting-place. 'If that is done I think we will achieve a much greater level of understanding throughout the industry in what are extremely difficult times.'

It was natural, with the pressures they were working in, that they should at times feel despondent, 'but I think that if we develop internal communications, and look at the reaction of people to us in our surroundings, we will see that their attitude towards the industry is becoming progressively more positive. They do realise that the gas industry is becoming new and vital and disturbing in a creative way. The shape of the new industry is already being implanted in the public mind, and this shape is of a new, live and vital force.'

France tackles sulphur problem in Lacq natural gas

THE Association Technique du Gaz en France held its 77th Annual Congress in Paris, from June 28 to July 2 (which was briefly reported in the 'JOURNAL' of September 14 on page 409), under the Chairmanship of its President, M. Yvan Quéret. Among the many foreign visitors the Institution of Gas Engineers was represented by its President, Mr. H. S. Cheetham, and Secretary, Dr. W. T. K. Braunholtz.

Most of the 36 technical communications presented for discussion dealt with subjects peculiar to the French gas industry, especially the rapid expansion of the Lacq natural gas project, but several are of general interest.

Refinery gases

M. Philippart and M. Papault described the utilisation of residual refinery gases in Normandy where these gases are available from the Esso-Standard refinery and that of the Cie Française de Raffinage, both of the Department of the Lower Seine. Some 600 mill. thermies (approximately 24 mill. therms) per annum have been delivered from the two sources to two reforming plants, a cyclic cracking plant of the Onia-Gegi type at Le Havre and an auto-thermal cracking plant of the Grande-Paroisse type at the Cokerie of Grand-Quevilly. The gases are transported by 56 miles of pipeline at pressures of 10-15 atmospheres.

Their analyses, 13 of which were tabulated, showed a wide range of high calorific values and hydrocarbon content. The two reforming plants were described: 'The utilisation (of these gases) presents difficulties due principally to sharp variations in their composition (particularly because) there is no mixing of the gases in the transmission lines. This imposes security restrictions in the installations which prevent the attainment of optimum results.' The presence of sulphur in the gases also leads to difficulties.

Emulsions

M. Henri Dumay of the Paris Region recorded the excellent results obtained with the use of tensio-active agents of the cationic type in breaking down emulsions of water and tar, which arise particularly in condensers and washers in the production of carburetted water-gas. Amino-220 and the bitrans prepared by Glovers (Chemicals) Ltd. were specially recommended.

The Wobbe Index

M. Jacques Coq and M. Pierre Faudier of Gaz de France Research described and discussed five types of apparatus available in France for measuring and recording the Wobbe Index of a supply gas; they followed this with a discussion of this figure on several characteristics of industrial utilisation. The several apparatuses described were the ACZC of Holland, OTIC of France, Reineke of Germany, Sigma of Great Britain and the Union of Germany. The theories of their respective operations were set out and results of tests tabulated.

The principles of the regulation of the Wobbe Index were then fully dealt with mathematically and apparatus for its regulation, the Sigma-Kent and the Union, were described and discussed.

Finally, the importance and advantages of the close regulation and control of the Wobbe Index in many industrial applications of gas were emphasised, especially in industries dependent on gas quality and particularly in certain mechanical glass-making plant, where the cost of this apparatus is quickly recovered in improved quality of production and reduction of rejects.

Deposits in safety appliances

The communication of M. Schneck of the Research Department reported tests undertaken to ascertain the conditions in which deposits of high carbon content are formed on the sensitive element of safety appliances in utilisation. It was noted that these deposits appeared most often in cold periods where peak-load plant was in use. The tests showed that deposits are accelerated by the presence of, among others, H_2S, ozone and metallic carbonyls. But, in general, when the composition of a gas allows, there exists in flames slightly aerated a zone productive of free carbon, and M. Schneck has studied the geometric conditions of the formation of these deposits on contact with the sensitive surface in this zone. Concluding, he recommended the use of the blue flame wherever possible and certain precautions to be taken in the design of safety appliances. A large number of tests were reported and results tabulated.

Tests on shunt type flues

M. Pérou of the Research Department reported a long series of tests. The shunt flue was defined as a collective conduit or chimney to which are connected the waste gas outlets of individual appliances serving each floor of a building equipped with this system. Each individual conduit passes up the collective chimney and does not debouch into the latter until the vertical travel is sufficient for the up-draught in it to be effective. If the height for draught is less than seven metres the individual flue debouches into the common flue just below the top of the latter.

The tests, undertaken at the request of the A.T.G., were carried out on two shunt-type flues, one covered with plaster, the other insulated with plaster bricks, built in a tower 19 metres high with six floors. At each floor, utilisation appliances of different types and sizes with gas or other fuels were installed and the whole was fully instrumented. Observations were tabulated. Results showed that the arrangement could be used for appliances of continuous operation without fear of down draught or excessive condensation.

Almost all the countries of Europe accept with certain reservations the connection of a number of appliances to a single flue. The French Ministry has authorised the shunt flue in buildings of at least five floors for heating apparatus, also with certain reservations.

Gas in glass manufacture

M. Hermans, Managing Director of Le Four Industriel Belge, gave results which had been obtained in glass and ceramics manufacture in tunnel and in chamber ovens by the use of a new convection burner known as the Imp impulse type.

The air and the fuel gas are mixed, in a static mixer unaffected by variations in pressure, and combustion completed in a refractory chamber where the products of combustion escape by a restricted outlet, at a gas speed of the order of 125 metres per second.

The Imp burners are mounted in banks each controlled by a thermostat and a mixer to obtain the necessary variations of atmosphere and temperature in the different zones of a tunnel-oven. The banks of burners are placed in relation to one another so as to create turbulence, although deflectors may be used for this purpose.

A great uniformity of temperature surrounding each object in the load is thus obtained, resulting in reductions of one half and even of one tenth in the time required for heat treatment. The construction of burners and ovens was described and illustrated by drawings and photographs.

Sulphur

M. Brisse and Mr. Pflugfelder of Lacq described apparatus for the continuous determination of total sulphur in the purified natural gas, before delivery to the transmission mains. The apparatus, which was described last year, is of sufficient accuracy to control these impurities within the limits prescribed by the Ministry.

By scrubbing the natural gas at Lacq with aqueous solutions of ethanolamine, a gas is reclaimed consisting essentially of H_2S and CO_2, which is treated by the Claus process for the production of free sulphur. The pilot installation was described by M. Bapseres and M. Comte and results were tabulated. It is anticipated that a full-scale plant will greatly reduce atmospheric pollution around Lacq, with economic advantages in the recovery of valuable products.

Meters of moulinet type

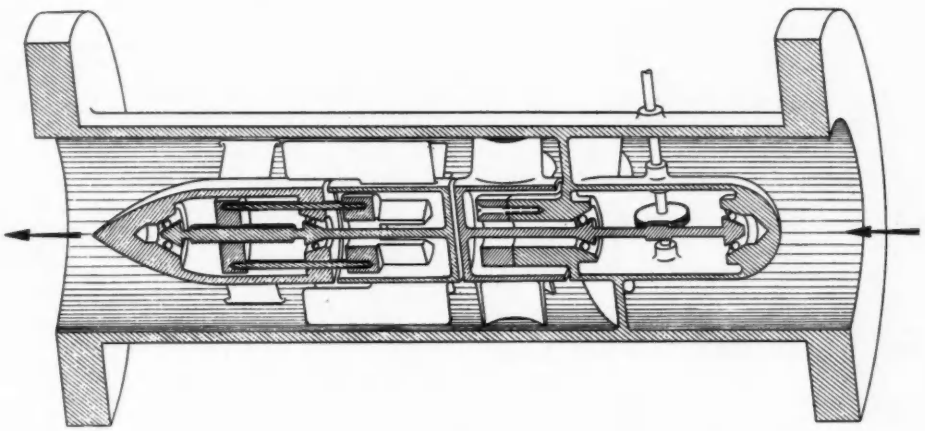
M. Souriau of the Research Department of Gaz de France described a gas meter of the moulinet (or propeller) type. It consists principally of a light helix, filling the whole cross section of the gas pipe and capable of rotating in bearings with a minimum of friction. Set in motion by the gas stream it gives a measure of the gas velocity.

The investigation was prompted by the need to find a meter of small dimensions that was cheap to construct, for use in distribution where meters represent a considerable proportion of the capital invested. It is recognised that meters of the propeller type require frequent standardisation and careful maintenance and they do not give an absolute measurement. A propeller with motor assistance has already been used but this requires an outside source of power and is of delicate construction. The apparatus here described (it is covered by a French patent) consists of 'a distributor which gives a rotary motion to the gas, a wheel with blades calculated to absorb totally this rotary motion at a convenient speed, and finally an auxiliary propeller operated by the outlet rotations of the gas and actuating a brake adjusted so that the wheel turns at the determined convenient velocity, the wheel operating the gears of the meter. The scheme is shown in the diagram reproduced.

A working model of this 'maximum efficiency propeller type meter' has been constructed and tested.

Storage of liquefied natural gas

M. Besnard and M. Vincent reported the first results obtained from a study at the Landy research station of Gaz de France, of the problem of the storage of liquefied natural gas. Laboratory work was carried out there on insulating materials and security problems, followed by tests on a semi-industrial scale and completed by observations of pilot plant for liquefying and storing natural gas at Nantes. Similar investigations are to be pursued into the storage of liquid methane.



The gas passes from right to left. In this direction there is the fixed distributor supporting the blades of the turbine; the turbine, actuating the gears of the meter; the moulinet (propeller) with straight blades activating a magnetic brake acting on the turbine; the streamlined block supporting the bearings of the moulinet with straight blades.

Odorisation

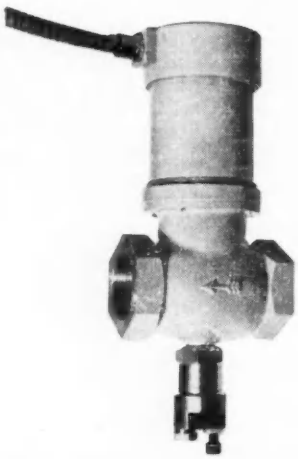
The new gases now replacing coal gas require odorisation. Madame Odette Angelraud of Landy reported a study of some odorants commercially available. Laboratory tests show that compounds of the sulphide type possess the properties best suited to the purpose from the points of view of adequate odorising power, low chemical reactivity to the metal of the pipe and the rust which may be present, low retention by this same rust, low absorption by oil mists or inhibitors, and good chemical stability. The results were tabulated.

At Saint-Etienne an odoriser, 'Spotleak,' has been used to detect service leakages. The supply is of coal-gas and a mixture of one part 'Spotleak' to two parts benzole is injected into the system at convenient points at the rate of 60 mg/m³ (say 0.01 p.p.m.) for about a day. The procedure is effective and cheap but it is necessary to obtain the understanding and collaboration of consumers through the Press and other publicity to avoid 'dirty gas' complaints.

Technical developments

Delayed action valve

ETHER LTD. have developed their range of solenoid valves for low-pressure town gas, so that they can now be supplied with a slow-opening and slow-closing characteristic as required. The time of opening and closing, which is readily adjustable by the user even after installation, can be varied between zero and 15 seconds.



The Ether solenoid valve.

Furthermore, the adjustment to closing is independent of the adjustment to opening. They have a dead-tight shut-off, are compact and easily serviced.—*Ether Ltd.*

Rust proofing oil

SYLRUST is a primer for rusted surfaces and enables them to be painted without the danger of the rust returning. It is an oil which will penetrate all corrosion down to the virgin metal.

Because it will only oxidise to a limited extent the film obtained is still flexible when the oxidation process is complete, contrary to paint oxidation in which the process continues virtually to eventual destruction of the paint film.

It will not form a skin in the tin, or deteriorate in any way with time; although it is an oil and therefore combustible, it contains no volatile solvents and therefore has a very high flash point; it will in no way damage brushes or sprays, and is completely harmless.

Sylrust is essentially a primer, and should have a coat of normal paint over it, but it will give a limited protection on its own. It is available in red or aluminium.—*The Sylglas Company.*

Metal rectifier equipments

THE Hackbridge and Hewittic Electric Co. Ltd., pioneers of static rectification based on the mercury arc rectifier, are taking an active part in the development and application of metal rectifiers of all types.

Among these are a 2,000-A 30-50-V selenium rectifier equipment for electro-chemical duty in a corrosive atmosphere, a 9-kW selenium rectifier equipment for industrial service, and an automatic taper charger for the battery of a fork-lift truck.

Other equipment manufactured is a 220 kVA single phase transductor for a large welding equipment, a complete selenium welding equipment with transductor control for 7.5-150 A d.c. complete with an h.f. unit for argon arc welding, and water-cooled germanium rectifier equipment. These incorporating provision for automatic current control to within fine limits, and many other special features.—*Hackbridge and Hewittic Electric Co. Ltd.*

American concrete anchor

ALREADY a success in many parts of the world, the Phillips 'Red Head' self-drilling permanent concrete anchor system is now available in Britain.

The 'Red Head' quickly cuts its own close-fitting hole into the toughest concrete without spalling. By inserting a simple expansion plug, it becomes a concrete anchor with tremendous holding power. It can be installed by hand, but a complete set of interchangeable chuck components enable it to fit all makes and models of air and electric impact hammers.

Requiring very little effort and no special skill, the 'Red Head' is as useful to the home handyman and building tradesman as it is to a whole host of industries, public utilities and Government departments.—*Phillips Drill Company.*

New tipping gear

THE Leyland Octopus, model 24.05 15 ft. 6 in. W.B. on an F.C. chassis, is fitted with a Pilot OV 15 gear incorporating the Pilot combined 2¼ in. PTO/unit, which

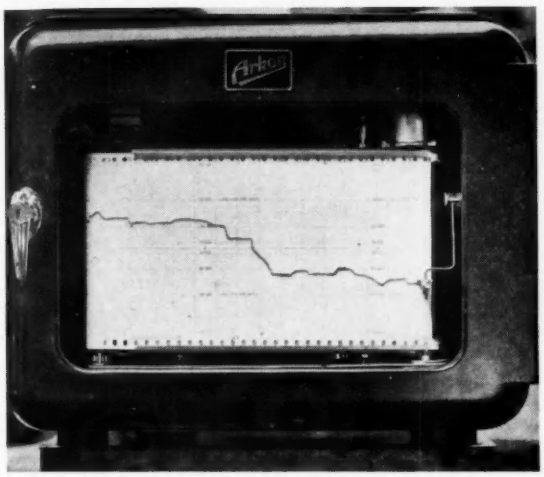
The Pilot tipping gear.

is hinged through the chassis frame at the rear to enable low loading. The body has a capacity of 18 cu.yd. with an inside length of 19 ft. 6 in., and is constructed of $\frac{3}{16}$ in. alloy plate with the exception of the ¼-in. plate floor; the corners of the body are of 6-in. radius. The spare wheel and batteries are not fitted behind the cab in the usual way, and this enables the body length to be approximately 18 in. longer than the standard body for this type of chassis,

and the overall height to be reduced to 8ft. 6 in. The makers of Pilot hydraulic tipping gear and bodywork are offering to supply a leaflet containing a body capacity calculating chart and a list of material weights free to anyone interested Such a chart enables anyone knowing the body length and the height of the sides of his lorry to calculate with speed its total cubical capacity.—*Pilot Works Ltd.*

Flow recorder

THE latest version of the Arkon Model 1601 Gas Flow Recorder automatically measures two-way gas flow on a chart having a centre zero. Flows in a forward direction are recorded above the centre line and reverse flows below. The latest version is designed for use with a straight pattern



The Arkon flow recorder

pitot tube which is suitable for mains with a diameter of four in. and greater. To insert the pitot tube into an existing main, it is only necessary to drill and tap a 1-in. hole, which can be resealed with a standard gas plug if it should be desired to move the pitot tube to a new location.—*Walker, Crosweller and Co. Ltd.*

Improved waterproof clothing

MANUFACTURED from a close weave cotton duck impregnated on the face side with a highly flexible P.V.C. coating, the DUCK-DRI range of waterproof clothing has been developed to fulfil the need for a supple, weatherproof medium weight garment that is comfortable to wear, yet will give long service under arduous working conditions. Extensive field tests have proved that DUCK-DRI garments possess a far greater tear-resistance than ordinary P.V.C. waterproofs made from materials with a rayon synthetic fibre base-cloth, giving them a far longer life. Tear-strength is considerably greater than that of conventional P.V.C. coated garments, and the garments have a greater abrasion resistance due to an additional 2-3 ounces of plasticiser per sq.yd., as well as a greater strength of base fabric. Smooth and silky to the touch, they have a reduced tendency to crease when stored for long periods, while the absorbent quality of the cotton duck fibres on the unproofed inside of the garment reduces the effects of condensation to a minimum. Added to this seams are screened with P.V.C. film and electronically welded. A deep storm collar with press stud fastening is fitted to jackets and long coats.—*Jeltek, Ltd.*

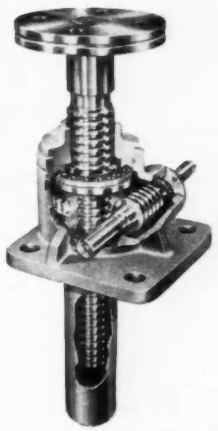
Resin removing cream

SYNTHETIC resins and glues are being used increasingly in many branches of industry; workers find that they adhere tenaciously to the skin and are difficult to remove from the hands after work. To overcome this problem Rozalex Ltd. have introduced a resin-removing cream.

This rapidly and effectively removes synthetic resins from the skin. In normal circumstances one application is sufficient to remove the resin, but if there is gross contamination a further application may be necessary. The cream is non-abrasive and harmless to the skin; it can therefore be used with absolute safety.—*Rozalex Ltd.*

Worm gear jacks

A new standard range of worm gear jacks, known as the Duff Norton 1800 series, consists of eight jacks with capacities of between two and 100 tons and has been specifically designed for building into machinery and equipment. Being mechanical in operation, the jacks can



A Duff Norton 1800 series jack

be connected by means of shafting and mitre gear boxes to lift in unison, even with an unevenly distributed load. They are self locking and can be used to hold loads of several hundred tons without creep occurring.

Features common to all jacks in the range include the use of heat treated phosphor bronze worm gear teeth, Alemite grease nipples and the absence of keying in the lifting screw, which allows the top to be bolted to the member being raised, so preventing the jack from turning. A clockwise rotation is employed for lifting the load, the maximum worm gear speed being 500 r.p.m. In the smallest and largest jacks in the range, a ball race and grease seal is fitted at each end of the worm, whilst Timken Taper bearings are used for jacks of between five and 25 tons capacity.

The weights of the range, based on a 6-in. lift, lie between 17 and 1,200 lb., the extra weight of each additional inch of lift in these sizes being .33 lb. and 9 lb. The standard range employs lifts up to 24 in., but greater lifts can be supplied where required.

Apart from their use as lifting jacks, the units in this new range may be employed as linear actuators, to push or pull horizontally and to apply pressure in any given direction. For any of these duties they may be either manually or motor operated, and since all units have a common lifting speed, any combination of sizes may be employed together, operated through gear boxes and shafting from a common power source.—*Consolidated Pneumatic Tool Co. Ltd.*

NEWS SUPPLEMENT

PUBLIC INVESTMENT WHITE PAPER

A GOVERNMENT White Paper has been issued dealing with public investment approved in principle for the next financial year. It is the first of its kind issued to help Parliament's scrutiny of public expenditure.

In June the Government decided to supplement its measures of restraint on the growth of demand by holding the approved level of public investment in 1961-62 to that of the current year. At the time, this totalled £1,730 mill.

But because of minor changes already foreseen, this has been revised downward by £20 mill. The present estimates suggest that the final figure may be in the neighbourhood of £1,670 mill.

TWO-FIFTHS

The programmes of the nationalised industries, coal, gas, electricity, the British Transport Commission and the air corporations, account for about two-fifths of all public investment.

Included in the totals (in mill. pounds) for 1961-62 and 1960-61 (as at October 1) respectively are: Coal 96 and 100; gas 47 and 38; electricity 358 and 337.

For gas, the plan for development up to 1965 provides for some investment in new methods of gas supply such as liquefied natural gas as a raw material. There are also projects for production and bulk transmission of gas by high-pressure pipeline and underground storage.

LURGI PLANT

Such projects are unlikely to call for appreciable expenditure as early as the year 1961-62, but the estimates for that year provide for expenditure of £4.8 mill. on the two plants for the total gasification of coal by the Lurgi process which are already under construction in Scotland and in the Midlands.

There will be a debate on public investment and economic policy in the House of Commons today and on Thursday arising from the Government motion already on the Order Paper, to take note of the White Paper.

The first day's debate is likely to be devoted to the investment programmes of the nationalised industries.

Sahara gas: 'Positive policy needed' says peer

THE possibility that the Gas Council would approve the purchasing of some thousands of millions of cu.m. of natural gas or methane a year from the Sahara, starting in 1962, was commented on in the House of Lords by Viscount Hall, opening a debate on the fuel and power industry.

Lord Hall had said that in the last few years the Government had ignored the crucial need for co-ordination between the fuel and power industries, and he added: 'Trusting to unregulated competition between coal, electricity, gas and atomic energy, the Government appear to be giving little thought to a positive policy, which is necessary, especially in relation to the future of the coal industry.'

It was, he said, 'strange that in the very few years of coal scarcity the nation has searched almost world-wide, and has spent large sums of money, for fuel to compete with our basic fuel upon which the prosperity of this nation and our great industries was based and maintained.'

'Heavy costs'

Now the nation had more coal than was required; oil and uranium were imported at heavy costs and they were informed by the Press of this Sahara possibility.

'The nation's finance bill for the importation of fuels to compete with coal has now become a great burden to our balance of trade, and many persons and organisations are convinced that the time has come when the Government should look more closely at the situation which is being created by the increasing flow of fuel oil imports from overseas refineries, the possibility of imports of natural gas and, indeed, the cost of the importation and the storage of uranium.'

Lord Mills, Paymaster General, replying to the debate, and referring to the import of liquid methane, said: 'It is true that there have been seven experimental shipments, and technically they have been successful; but there has been no proposal as yet for any large-scale importation.

'Small shipments'

'These shipments were quite small—I think about 1% of the particular Gas Board's output. That is all that was covered by these seven shipments. But as yet no proposal has been put to the Minister of Power.

'If such a proposal is put to him your Lordships may rest assured that he will take every consideration into account, including the situation of the coal industry.

'So I do not think I can really say anything more about it, because there has not as yet been a proposal submitted to the Minister.'

A far thing

A COIN found by an East Midlands Gas Board workman excavating on a housing estate in Cox's Lane, Mansfield Woodhouse, Nottinghamshire, has been identified as Roman, minted nearly 1,800 years ago.

8-hour flare as gas ignites by manhole

GAS that was believed to have leaked into a sewer from a high-pressure main and then escaped through a manhole, burst into flame near traffic lights on the North Circular Road, in North-west London, on Sunday, when a motorist attempted to start his engine.

A section of the road was closed and traffic diverted. North Thames Gas Board officials and workmen, with about 100 firemen, who arrived to deal with the situation, left the gas burning until the source of the leak was found, for reasons of safety.

It was nearly eight hours before the area of the leak was located and the flame could be extinguished.

About 150 people were evacuated from their homes as a safety measure. A senior fire officer was reported by 'The Times' as saying 'Luckily the freak fire not only disclosed the leak but provided a safety valve, burning up the gas.

Four of the men digging to locate the leak were overcome by the fumes.

The only occupant of the car, a man, leapt to safety but the sheet of flame enveloped the vehicle.

New reforming plant at Crewe

A 2 mill.-cu.ft. per day reforming plant employing the M.S. process is to be installed at the North Western Gas Board's works at Crewe by the Woodall-Duckham Construction Co. Ltd.

With p.f.d. as its raw material, the new plant, including all ancillaries, will cost £250,000 and is due for completion in September 1961.

Altrincham win North West window contest

THE North Western Gas Board has just held its sixth annual Window Display Competition, in which 143 showrooms competed. Altrincham won, with 85 points out of a possible 100, being 12 marks ahead of their nearest rival, Liverpool.

The winning entries from eight groups were judged by a panel: Mr. Alan Edney, General Publicity Manager of Radiation Ltd.; Miss Florence Dobson, Principal Public Relations Assistant, Board H.Q.; Mr. J. W. Rodgers, Sales and Service Officer, and Mr. Clifford Walker, Board Display Officer, who went to see the winning windows.

Marks were given for attraction, selling power, execution, message, and showroom continuity, 20 marks for each. The latter is an important innovation. The theme had to be continued from the window into the showroom.

The purpose of the competition is to interest the showroom staffs in window display work, and professional help is restricted to the pictorial work, letter cards, etc.

This year the subject of the competition was 'Fanned warm air heating'—a difficult theme, but one which was executed with originality and finish.

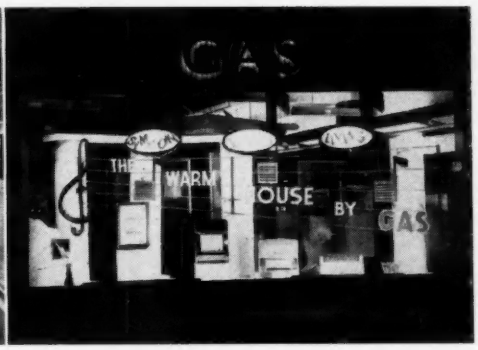
The displays started off the space heating sales campaign.

Mr. Rogers said: 'These competitions have immensely improved the standard of window displays throughout the area.

'Head Office has helped with packaged displays, which are prepared and sent out to all the showrooms in the area at least five times a year, but the quality of the work done by our showroom people has been beyond praise.

'It has been consistently high and the judges' task in selecting the winning display was very difficult indeed.'

The trophy, a silver figure of Mercury, with prizes to the value of £25, will be presented to the Altrincham staff responsible for the winning display.



In the left hand picture are the judges, who are (from left to right): Mr. A. H. Edney, General Publicity Manager, Radiation Ltd.; Miss Florence Dobson, North Western Gas Board Public Relations Office; Mr. J. W. Rodgers, Sales and Service Officer to the Board; and Mr. C. Walker, the Board's Display Officer. The right hand picture shows the winning entry, the Altrincham Showroom.

Southern Board opens central heating drive

CENTRAL heating courses for gas salesmen are being held by the Southern Gas Board. Introducing the series, Mr. W. J. Steed, Assistant Commercial Manager of the Board, said that during the past summer they had sold more gas fires than they had previously sold in any winter. 'Now we want to do the same thing for central heating,' he said.

The technical side of the operation was dealt with by Mr. C. Wadsworth, Technical Assistant, and Mr. N. H. Greenway, Industrial Development Engineer, who discussed capital, installation and running costs and the details of various installations.

Advertising and display was dealt with by the Board's Publicity Manager, Mr. G. D. Phillips.

Mr. C. Wadsworth, (left), talking to Southampton Salesmen. With him are Mr W. J. Steed and Mr. N. H. Greenway.

Reds make big oil/gas discoveries

THE Soviet Academician Dmitry Nalivkin, says that Soviet oil and gas fields, discovered in the Central Asian republics and North-West Kazakhstan, can easily be compared with those in the Middle East. Mr. Nalivkin, who edited a geological survey of the country four years ago, spoke of 'very pleasing results' shown by recent big explorations.

He recalled, in a recent interview with 'Izvestia' that the Gazlin deposits, the largest of their kind in the U.S.S.R. with estimated reserves of over 400,000 mill. cu.m., had been found in the Bokhara region.

He added that there was every reason to believe that new deposits would be discovered in the Bokhara-Khiva region in the near future.

He said that Siberia would become a new major oil and gas producer. Several gas deposits had already been surveyed in the area of Berezov and Shaim, and big deposits had been found in Yakutia. He said that extensive prospecting was under way for rare elements.

Ammonia from natural gas in Florida

NATURAL gas will be used as the raw material in a new ammonia plant to be built in the United States. The plant and associated facilities is to be built by Chemical Construction Corporation for U.S. Phosphoric Products in Tampa, Florida.

The ammonia synthesis converter, which will have the largest designed capacity in the world, will employ, in addition to gas reforming, carbon dioxide removal by a combination of potassium carbonate scrubbing and 'MEA clean up.' Methanation will provide final purification before the ammonia synthesis operation.

The date set for the completion of the plant, which will have a capacity of 350 tons a day, is late 1961.

Weekly statistics

The total amount of gas available at gasworks for the week ended October 23, 1960, was 57.3 mill. therms. During the week ended October 22, 1960, the gas industry consumed 416,000 tons of coal, and coke ovens consumed 556,000 tons. Stocks of coal held by the gas industry for the same week stood at 1.962 mill. tons, and by coke ovens at 1.452 mill. tons.

Clean air conference: Accent on solid fuels

THE 27th conference sponsored by the National Society for Clean Air was held in Harrogate from October 5-7, and with it was an exhibition which was open to the public. This was very comprehensive of all fuels but the accent was on solid fuels.

The exhibitors were divided into three categories: The nationalised industries, with Societies and Councils, including the Solid Smokeless Fuels Federation, Women's Advisory Council on Solid Fuels, N.I.F.E.S. and the C.U.C.; engineering firms concerned with industrial installations, and finally the domestic appliance manufacturers. The latter category appeared to be rather under-represented in the gas section.

The gas industry was featured by the North Eastern Gas Board, showing how old coal burning grates could be converted to coke, a number of modern coke appliances, the 'Caloric' incinerator and a warm-air installation.

Among the gas industry's old friends in the engineering section, the largest number were those concerned with dust collection and precipitation.

These were: Chemical Construction Co. (G.B.) Ltd., London; Davidson & Co. Ltd., Belfast; Filter-Heat Ltd., Rugeley (a subsidiary of Sutcliffe, Speakman & Co. Ltd., Leigh); E. Green & Son Ltd., Wakefield; W. C. Holmes & Co. Ltd., Huddersfield; Lodge-Cottrell Ltd., Birmingham; and Simon-Carves Ltd., Stockport.

Crosthwaite Furnaces & Scriven Machine Tools Ltd., had on display a gravity-fed, self cleaning boiler suitable for a wide range of fuels, and Bolton Superheater and Pipeworks Ltd., the 'Bolton-Gray' ash blowing equipment.

North Eastern Gas Board stand at the National Society for Clean Air Conference and exhibition at Harrogate.

Well-known names among appliance manufacturers were: Allied Ironfounders Ltd., exhibiting the 'Kayenco' boiler; Cannon (G.A.), Ltd., the GasMiser room heater with thermostat; Newton Chambers & Co., Ltd., in co-operation with the National Carbonising Co. Ltd. (Rexo), showing the range of Redfyre appliances; Thomas Potterton Ltd., their boiler; and Radiation Group Sales Ltd., the Parkray family of smokeless solid fuel appliances.

Payroll theft

In a payroll theft at the Lurgi gasification plant at Westfield, £1,000 was taken from the site during the lunch hour. The money, due to be paid out to the workmen of one of the sub-contractors, was in a wooden hut.

COMING EVENTS

November 16.—THE INSTITUTION OF CHEMICAL ENGINEERS, NORTH WESTERN BRANCH: Lecture Theatre A, The Houldsworth School of Applied Science, Reservoir Street, Leeds 2. 'Electrical Hazards in the Chemical Industry,' by F. Clark. 6.30 p.m.

November 17.—THE SOCIETY OF INSTRUMENT TECHNOLOGY, CONTROL SECTION: Manson House, 26, Portland Place, London, W.1. 'The Control of a Single Effect Concentrating Evaporator—Dynamic Characteristics and Analogue Computer Study,' by F. P. Lees and J. A. Anderson. 7 p.m.

November 18.—THE JUNIOR INSTITUTION OF ENGINEERS: Pepys House, 14, Rochester Row, Westminster, S.W.1. Chairman's Address, 'Simple Instruments for Tanks and Pipelines,' by E. M. Baskerville. 7 p.m.

November 22. — MIDLAND JUNIORS: 'The Economic Use of Steam on Two Large Gas Works,' by C. Halstead.

Board acts on noise plea

COMPLAINTS about the noise nuisance at the Lurgi gasification plant being built at Westfield have been swiftly met by the Scottish Gas Board.

The noise, which was said to keep Ballingry people awake, was declared a public nuisance by Dr. G. S. Riddell, Fife Medical Officer of Health. The Scottish Gas Board at Westfield stated that they were already well ahead with adjustments to reduce the noise, which appeared to be caused mainly by steam escaping from their boiler plant.

The statement continued: 'We reduced the velocity of the steam on the same afternoon that we first heard the complaint, and now the boiler is shut down and we are carrying out further modifications. I think we shall be able to keep everyone happy.'

PERSONAL NOTES

MR. THEO ROSS, of Arbroath, District Manager for the Dundee and Arbroath groups of the Scottish Gas Board, has been appointed Management Officer for the North-east area of the Board. He will have twelve gas undertakings in his district, and his headquarters will be in Aberdeen. Mr. Ross went to Arbroath six years ago as manager of the local gas works, and later became district manager. He is to be succeeded at Arbroath by MR. ROBERT QUEEN, Divisional Service and Sales Manager for the Aberdeen area.

MR. RONALD E. CHANDLER, Service and Sales Manager with Dundee group, Scottish Gas Board, has been appointed to a similar post at Walsall. He went to Dundee from West Bromwich three years ago.